In the Entrance Foyer—Washington Irving High School, New York.

American School Building Standards

WILBUR T. MILLS, Architect
A. A. I. A.

FRANKLIN EDUCATIONAL PUBLISHING COMPANY
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1915

TO MY BROTHER

Edwin Stanton Mills

This book is affectionately dedicated by

—THE AUTHOR.

The Champlin Press, Columbus, Ohio

PREFACE TO FIRST EDITION

The present work is offered to the public in the belief that there is still great need for the dissemination of reliable information regarding correct design and construction in public school buildings in this country, and that "every little helps."

The author makes no claim of originality for most of the matter contained in the work, unless it be as regards arrangement and selection. He has drawn freely upon all the well known modern works upon the subjects treated, modifying conclusions as experience and the most recent authorities approve. The controlling motive has been to so condense and standardize the best present day practice as to produce a compact handbook for ready reference, eliminating both the historical and purely aesthetic phases of the subject, for the sake of utility.

The author acknowledges help received from, and opinions influenced by, publications of The Boston Schoolhouse Commission, Mr. Edmund M. Wheelright, Prof. A. D. F. Hamlin of Columbia University, Mr. Warren R. Briggs, Mr. M. C. Huyett, Prof. Rolla C. Carpenter of Cornell University, Prof. S. H. Woodbridge of the Massachusetts Institute of Technology, Mr. R. Clipston Sturgis, Mr. W. B. Ittner and others.

PREFACE TO THE SECOND EDITION

The changes in this edition consist of the omission of the former chapter "The Man Who Knows"; revision of all other chapters—particularly that one entitled "Selecting an Architect," referring to competitions, etc.; revision of all state codes, bringing them up to date; and the correction of much other data throughout the work.

Additional chapters have been added entitled, "The Wider Use of the School Plant," and "The Cost of School Buildings," with tables of costs from the Boston and St. Louis annual reports covering the past ten years.

Perhaps the most important addition is a set of tables, some original with the author and others long in use but selected with special reference to school building design. In presenting these tables, no effort is made to cover any part of the engineering field but only to render this work complete for its purpose as a guide in school building design.

Finally, the list of school buildings has been so increased and extended as to cover adequately all sections of the country, and illustrations of interiors, details, special rooms, etc., added to illustrate as fully as possible the best present day American practice.

Acknowledgment is made to The U. S. Bureau of Education, and the Russell Sage Foundation, the use of whose publications in the preparation of this work has been of material assistance; also to Mr. Charles L. Hubbard, whose articles on Heating and Ventilating in The American Architect have supplied some of the data employed in the revised chapters on Heating and Ventilating.

INTRODUCTION

The recent movements in education as affected by legislation have emphasized the physical plant as the basis of successful school practice. School architecture,—including all the problems of safety, sanitation, heating, lighting, ventilation and others, having the physical well-being of the pupil in mind,—has been the earnest study of many of the leading architects in the country. The legislatures have attempted to embody in the laws of the several states the principles approved by an enlightened public sentiment. Boards of Education and building committees have often been perplexed and in doubt when attempting to meet the needs of their communities. Mr. Mills in his "American School Building Standards" has put within easy reach, in a systematic form, all the essential problems of school architecture. The new movement to utilize more fully the school buildings for social and community purposes has introduced some new features both in the forms of the buildings and the methods of furnishing. Industrial and Vocational Education also present new needs. There is no public problem more important to all the people than that surrounding the education of the children. The proper housing of the children during school hours, and adequate provision for play are vital to their future citizenship.

Mr. Mills in his book has brought together in easily accessible form the legislation of the several states having school codes and the complete code of the city of Boston. Standard methods of construction and the best practices of the country are set out. It will be understood that in the rapidly changing conditions of the country no book will long be up-to-date in the details of the information presented and this second edition will doubtless be welcomed by those who made use of the first edition. An experience of nine years on a city Board of Education has taught me the necessity of great care by the building committees in prosecuting the work of building and improvement of school

property. Every effort looking toward the perfecting of school buildings should have cordial support. Boards of Education and Architects will find a hand book such as Mr. Mills has prepared an excellent guide in these matters.

The selection of an architect is of course the most vital issue before Boards of Education when a building is to be erected, but even when the most competent men are secured there remains the necessity of careful study by the school authorities. Reference to a digest of the laws and practices of the country will often serve to correct and avoid errors that might perpetuate themselves for a generation or be corrected at heavy expense.

The demand for a second edition of this book is a significant comment on the place it filled, and the author is to be commended for his painstaking service to the public.

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SELECTING AN ARCHITECT

It has been well said that the public school concerns intimately more people than any other class of public edifices because (1) every citizen avails himself of its privileges in his youth, and sends his children to it in later years; and (2) its design and construction unquestionably affects, for better or worse, the health, happiness and morals of the pupils, whatever may be the effect of the educational work carried on therein.

Much has been done in some states, and large cities, toward standardizing and formulating data of school building design. Every school board member and every architect of school buildings who does not master, in so far as he can, all such details—which are now readily procurable—neglects a grave civic duty; a duty which, as Professor Hamlin says, "is all the more imperative when one reflects how large a span of the life of a community is spent within the walls of its schools, and how important it is to surround its children with the most perfect environment for their hours of study. The school houses of any community are the gauges of its enlightenment. They should be the best and most carefully constructed buildings it possesses—not the most splendid and ornate—but the most perfect in design and most complete and thorough in execution and equipment."

These facts granted, one can hardly lay too much stress on the importance of highly skilled architectural or engineering service (or both) in the design and construction of school buildings. Any school building which is at all worthy of a competent architect's attention, merits the services of the best man who can be induced to undertake the work. Even were the financial difference necessary to secure the best man an item of considerable size—and usually it is not—this is nothing compared to the risks otherwise involved. No power on earth can force an incompetent practitioner to do high grade, satisfactory work, or a dis-

honest one to do an honest job. No matter how many "smart" or "practical" men may sit upon a board, good work cannot be squeezed out of a poor architect, or honest work out of a rogue.

Immediately the question arises, how may a board be sure of selecting a satisfactory man? Like the "shortest road to the yaller jackets' nest," the infallible method "aint been discovered yet." But out of the experience of many boards and many architects certain conclusions are now available and safe.

The first of these is that, whenever possible, the architect should be chosen without competition by individual selection—upon the basis of integrity, professional skill and experience, just as men in other professions are selected. Where no sufficient reasons exist for doing otherwise, this is by far the simplest, easiest and least expensive method, and leaves no sore places to be healed up.

In case it is desired to consider more than one man on the individual basis, any desired number may be thus considered and judged, either by personal hearing or from written and photographic credentials (relating to executed work, etc., and *not* competitive sketches) but care should be exercised to extend to each candidate an absolutely equal and impartial hearing. Supporters of the personal method of selection offer the following arguments in its favor:

(1) Any other method involves competition among several architects, the waste of much time, often much needless expense,—both to owners and competitors, much annoyance and sometimes hard feelings.

(2) In all competitions on the basis of drawings the gambling instinct is appealed to, and the prospect of winnning the prize tempts architects to submit the sort of work MOST LIKELY TO WIN, regardless of real architectural merit; and unless the owner retains professional advisers to guide him, he, being incompetent to judge, is almost certain to select unwisely.

(3) Even if, by accident, the owner selects a competitive DESIGN of real merit, he runs the risk of thus choos-

ing a MAN brilliant in design but inexperienced or unsafe in constructive ability, or perhaps even utterly irresponsible.

(4) Under the very best conditions of competition it is exceedingly difficult to select an architect with absolute fairness to each competitor, and it is practically impossible when the owner trusts his own untrained judgment to make the selection.

However, in spite of these seemingly conclusive arguments against competitions, it remains a fact that, aside from private work done for individuals, the great majority of important architectural contracts are, have always been, and perhaps always will be awarded by competition of one sort or another. And the following are some of the reasons offered in explanation of this state of affiairs..

1. Architects themselves are not of one mind in opposing competitions. The American Institute of Architects selemnly pronounces against competitions and yet, recognizing their prevalence and growth, spends years trying to formulate a satisfactory code for their regulation. Meantime, some of its most prominent officers and members engage in competitions,—and indeed, some of them would hardly be known, or able to continue in architecture without such practice.

2. The People practically demand competition in public work, and look with suspicion and distrust upon all contracts not so awarded. Nothing offers the yellow journal a more welcome subject for sensation and cries of "Graft" than an award without giving at least several good men a chance. As a result, there are but few monumental public, or even semi-public buildings in this country, the architects of which were not selected by competition of some sort, while the list of those important building designs selected in competitions, and of those architects who have become famous thereby would be a long and representative one.

3. Many individuals and bodies of men claim to see great advantages in competitions arising from the number of different designs or schemes presented to choose from, these being the work of trained minds all directed to the solution of a given problem; and some—but not all by any menas—are willing to

pay all competitors in order to secure this real or fancied advantage.

4. In many cases, competitions are unavoidable, such as the requirement of competitions by law, or by condition of bequests, or by reason of inability to choose otherwise from among equals in ability or favoritism. And, as above stated, they are almost unavoidable in public work.

To express in a word the best thought and advice upon the subject: Be good, and if you can't be good, be as good as you can. Always be sure your architect is "The man who knows." If such a man, having the requisite integrity, ability and exiperience is available, have nothing to do with competitions. But if no such man is readily available, or if any reason exists, such as above suggested, why the competition is wise, necessary or unavoidable, then arrange your competition and its requirements with the utmost care, being particularly watchful to have its terms wise, honest and fair to all concerned,—or better yet, turn the whole matter over to professional advisers who KNOW HOW to guide you safely and wisely.

Since its foundation, over fifty years ago, the American Institute of Architects has given much attention to the conduct of competitions, and altho the Institute at this time comprises less than fifteen per cent of those who call themselves architects in the United States, its present conclusions unquestionably represent the combined efforts of very many able men, both inside and outside the profession, to find a satisfactory basis on which to conduct competitions. The attitude of the Institute is expressed as follows:

When a competition is necessary or desirable it should be of such form as to establish equitable relations between the owner and the competitors.

To insure this:

(1.) The requirements should be clear and definite, and the statement of them, since it must be in technical terms, should be drawn by one familiar with such terms.

(2.) The competency of all competing should be assured. The drawings submitted in a competition are evidence, only in part, of the ability of the architect to execute the building. The owner, for his own protection, should admit to the competition only those to whom he would be willing to entrust the work; that is, to men of known honesty and competence.

(3.) The agreement between the owner and the competitors should be definite, as becomes a plain statement of business relations.

(4.) The judgment should be based on knowledge, and since ideas presented in the form of drawings are intelligible only to a trained mind, judgment should not be rendered until the owner has received competent technical advise as to the merits of those ideas.

To sum up: To insure the best results a competition should have (1) a clear program, (2) competent competitors, (3) a business agreement, (4) a fair judgment.

Fifteen years ago many competitions had none of these provisions and few had all of them. The commonest form of competition was one that was open to all, had a program prepared by a layman, was judged by the owner without professional assistance, contained no agreement, and made no provision to eliminate the incompetent.

Even in the few years since the Institute first made its firm stand against the abuses of competitions, the effect of that action has been far greater than could have been foreseen. It has not altogether eliminated ill-regulated competitions, but it has greatly reduced their number, and it is safe to say that no competition of prime importance is now conducted except in accordance with the principles stated in the following Circular of Advice.

A CIRCULAR RELATIVE TO ARCHITECTURAL COMPETITIONS

Competitions are instituted to enable the owner* to choose an architect through comparison of the designs submitted. The

*The person, corporation or other entity instituting a competition, whether acting directly or through representatives, is herein called "the owner."

American Institute of Architects, believing that the interests of both owner and competitors are best served by fair and equitable agreements between them, issues this circular as a statement of the principles which should underlie such agreements.

The Institute does not assume to dictate the owner's course in conducting competitions, but aims to assist him by advising the adoption of such methods as experience has proved to be just and wise.

So important, however, does the adoption of such methods appear to architects that members of the Institute do not take part in competitions except under conditions based on this circular and specifically set forth in Articles 16 and 18.

(1) *On Competitions in General.*—A competition exists when two or more architects prepare sketches at the same time for the same project.

(2) *On the Employment of a Professional Adviser.*—No competition shall be instituted without the aid of a competent adviser. He should be an architect of the highest standing and his selection should be the owner's first step. He must be chosen with the greatest care, as the success of the competition will depend largely upon his experience and ability.

The expert's advice is of great value to the owner, for example, in so drawing the program as to safeguard him against the employment of an architect who submits a design largely exceeding in cost of execution the sum at his disposal, and in helping him to avoid the disappointment, embarrassment and litigation which so often result from competitions conducted without expert technical advice.

The duties of the expert are to advise those who hold the competition as to its form and terms, to draw up the program, to advise in choosing the competitors, to answer their questions, and to conduct the competition.

(3) *On the Forms of Competition.*—The following forms of competition are recognized:

Limited. In this form, participation is limited to a certain number of architects whose names should be stated in the program

and to any one of whom the owner is willing to entrust the work. In a limited competition the competitors may be chosen (*a*) from among architects whose ability is so evident that no formal inquiry into their qualifications is needed, or (*b*) from among architects who make application accompanied by evidence of their education and experience.

The limited form has the advantage that the owner and the professional adviser may meet competitors and discuss the terms of the competition with them before the issuance of the program. Form (*a*) is the simplest and most direct form of competition.

Open. The Institute believes that a competition open to all who wish to participate without regard to their qualifications is detrimental to the interests alike of owner and of architects. It will, therefore, give its approval to that form only when conducted in two stages, since by that means alone it is possible to insure anonymity of submission while safeguarding the owner's interests against the selection as winner of a person lacking the qualifications set forth in Article 4 hereof.

In this form there is a first stage open to all, in which the competitive drawings are of the slightest nature, involving only the fundamental ideas of the solution. These drawings are accompanied by evidence of the competitor's education and experience. From the first stage a small number who have thus demonstrated their competence to design the work and to carry it successfully into execution are chosen to take part in a final and strictly anonymous stage involving competitive drawings of the type indicated in Article 8 hereof.

(4) *On the Qualification of Competitors.*—The interests of the owner may be seriously prejudiced by admitting to a limited competition or to the second stage of an open competition any architect who has not established to the satisfaction of the owner his competence to design and execute the work.

It is sometimes urged that by admitting all who wish to take part some unknown but brilliant designer may be found. If the object of a competition were a set of sketches, such reasoning

might be valid. But sketches give no evidence that their author has the matured artistic ability to fulfil their promise, or that he has the technical knowledge necessary to control the design of the highly complex structure and equipment of a modern building, or that he has executive ability for large affairs, or the force to compel the proper execution of contracts. Attempts have often been made to defend the owner's interests by associating an architect of ability with one lacking in experience. These have generally resulted in failure.

As the owner should feel bound, not only legally, but in point of honor, to retain as his architect the competitor to whom the award is made, it is essential that the competitors in a limited competition, or in the second stage of an open competition, should be selected with the greatest care in consultation with the professional adviser, and that there should be included among them only architects in whose ability and integrity the owner has absolute confidence, and to any one of whom he is willing to entrust the work.

(5) *On the Number of Competitors.*—Experience has demonstrated that the admission of many competitors is detrimental to the success of a competition. When there are many, each knows that he has but a slight chance of success, and he is therefore less aroused to his best effort than when there are but a few. As the owner is interested only in the best result, he is ill-advised to sacrifice quality for quantity.

(6) *On Anonymity of Competitors.*—Absolute and effective anonymity is a necessary condition of a fair and unbiased competition. The signing of drawings should not be permitted nor should they bear any motto, device or distinguishing mark. Drawings and the accompanying sealed envelopes containing their author's names should be numbered upon receipt, the envelopes remaining unopened until after the award.

(7) *On the Cost of the Proposed Work.*—No statement of the intended cost of the work should be made unless it has been ascertained that the work as described in the program can

be properly executed within the sum named. In general it is wiser to limit the cubic contents of the building than to state a limit of cost.

The program should neither require nor permit competitors to furnish their own or builders' estimates of the cost of executing the work in accordance with their designs. Such estimates are singularly unreliable. If the cubage be properly limited they are unnecessary.

(8) *On the Jury of Award.*—To insure a wise and just award and to protect the interests of both the owner and the competitors, the competitive drawings should be submitted to a jury so chosen as to secure expert knowledge and freedom from personal bias.

Such a jury thoroughly understands and can explain the intent of the drawings. It discovers from them their authors' skill in design, arrangement and construction. Because of its trained judgment its advice as to the merits of the designs submitted is of the highest value to the owner.

The jury must consist of at least three members, one of whom must, and a majority of whom should, be practicing architects. One or more members of the jury may be chosen by the competitors.

It is the duty of the jury to study carefully the program and all conditions relating to the problem and the competition before examining the designs submitted; to refuse to make or recommend an award in favor of the author of any design that does not fulfil the conditions distinctly stated as mandatory in the program; to give ample time to the careful study of the designs; and to render a decision only after mature consideration. The jury should see to it that a copy of its report reaches every competitor.

The professional adviser should not be a member of the jury, as his judgment is apt to be influenced by his previous study of the problem.

(9) *On the Competitive Drawings.*—The purpose of an architectural competition is not to secure fully developed plans,

but such evidence of skill in treating the essential elements of the problem as will assist in the selection of an architect. The drawings should, therefore, be as few in number and as simple in character as will express the general design of the building. A jury of experts does not need elaborate drawings.

(10) *On the Program.*—The program should contain rules for the conduct of the competition, instructions for competitors and the jury, and the agreement between the owner and the competitors. Uniform conditions for all competitors are fundamental to the proper conduct of competitions. Lengthy programs and detailed instructions as to the desired accommodations should be avoided, as they confuse the problem and hamper the competitors. The problem should be stated broadly. Its solution should be left to the competitors.

A distinction should be clearly drawn between the mandatory and the advisory provisions of the program, *i. e.*, between those which if not met preclude an award in favor of the author of a design so failing and those which are merely optional or of a suggestive character. The mandatory requirements should be set forth in such a way that they cannot fail to be recognized as such. They should be as few as possible, and should relate only to matters which cannot be left to the discretion of the competitors.

It is difficult to summarize briefly the program, but it should at least:

(*a*) Name the owner of the structure forming the subject of the competition, and state whether the owner institutes the competition personally or through representatives. If the latter, name the representatives, state how their authority is derived, and define its scope.

(*b*) State the kind of competition to be instituted, and in limited competitions name the competitors; or in open competitions, if the competition is limited geographically or otherwise, state the limits.

(*c*) Fix a time and place for the receipt of the designs. The time should not be altered except with the unanimous consent of the competitors.

(*d*) Furnish exact information as to the site.

(*e*) State the desired accommodation, avoiding detail.

(*f*) State the cost if it be fixed or, better, limit the cubic contents.

(*g*) Fix uniform requirements for the drawings, giving the number, the scale or scales, and the method of rendering.

(*h*) Forbid the submission of more than one design by any one competitor.

(*i*) Provide a method for insuring anonymity of submission.

(*j*) Name the members of the jury or provide for their selection. Define their powers and duties. If for legal reasons the jury may not make the final award, state such reasons and in whom such power is vested.

(*k*) Provide that no award shall be made in favor of any design until the jury shall have certified that it does not violate any mandatory requirement of the program.

(*l*) Provide that during the competition there shall be no communication relative to it between any competitor and the owner, his representatives or any member of the jury, and that any communication with the professional adviser shall be in writing. Provide also that any information, whether in answer to such communications or not, shall be given in writing simultaneously to all competitors. Set a date after which no questions will be answered.

(*m*) State the number and amount of payments to competitors.

(*n*) Provide that the professional adviser shall send a report of the competition to each competitor, including therein the report of the jury.

(*o*) Provide that no drawing shall be exhibited or made public until after the award of the jury.

(*p*) Provide for the return of unsuccessful drawings to their respective authors within a reasonable time.

(*q*) Provide that nothing original in any of the unsuccessful designs shall be used without consent of, and compensation to, the author of the design in which it appears.

(*r*) Include the contract between the owner and the competitors.

(*s*) Include the contract between the owner and the architect receiving the award.

(11) *On the Agreement.*—An owner who institutes a competition assumes a moral obligation to retain one of the competitors as his architect. In order that architects invited to compete may determine whether they will take part it is essential that they should know the terms upon which the winner will be employed; and it is of the utmost importance to the owner that those terms should be so clearly defined that no disagreement as to their meaning can arise after the award is made. Unless they be so defined, delay is likely to occur and disagreements to arise at a time when a complete understanding between owner and architect is most important for the welfare of the work.

Therefore, there must be included in the program a form which guarantees the appointment of one of the competitors as architect and provides an agreement operative upon that appointment, defining his employment in terms consonant with the best practice. This must conform in all fundamental respects to the typical form of agreement appended to this circular.

(12) *On Payments to Unsuccessful Competitors.*—In a limited competition and in the second stage of an open competition each competitor, except the winner, should be paid for his services.

(13) *On Legality of Procedure.*—It is highly important that each step taken in connection with a competition and every provision of the program should be in consonance with law. Those charged with holding the competition should know and state their authority. If they are not empowered to bind their principal by

contracts with the competitors, they should seek and receive such authority before issuing an invitation.

If authority cannot legally be granted to the jury to make the award, that fact should be stated, and the body named in which such authority is vested.

(14) *On the Conduct of the Owner.*—In order to maintain absolute impartiality toward all competitors, the owner, his representatives and all connected with the enterprise should, as soon as a professional adviser has been appointed, refrain from holding any communication in regard to the matter with any architect except the adviser or the jurors. The meeting with competitors described in Article 3 is of course an exception.

(15) *On the Conduct of Architects.*—An architect should not attempt in any way, except as a duly authorized competitor, to secure work for which a competition is in progress, nor should he attempt to influence, either directly or indirectly, the award in a competition in which he is a competitor.

An architect should not accept the commission to do the work for which a competition has been instituted if he has acted in an advisory capacity, either in drawing the program or making the award.

An architect should not submit in competition a design which has not been produced in his own office or under his own direction.

No competitor should enter into association with another architect, except with the consent of the owner. If such associates should win the competition, their association should continue until the completion of the work thus won.

During a competition, no competitor should hold any communication relative to it with the owner, his representatives or any member of the jury, nor should he hold any communication with the professional adviser, except it be in writing.

When an architect has been authorized to submit sketches for a given project, no other architect should submit sketches for it until the owner has taken definite action on the first sketches,

since, as far as the second architect is concerned, a competition is thus established.

(16) *On the Participation of Members of the Institute.*—Members of the American Institute of Architects do not take part as competitors or jurors in any competition the program of which has not received the formal approval of the Institute, nor does a member continue to act as professional adviser after it has been determined that the program cannot be so drawn as to receive such approval.

(17) *Committees.*—In order that the advice of the Institute may be given to those who seek it and that its approval may be given to programs in consonance with its principles, the Institute maintains the following committees:

(*a*) The Standing Committee on Competitions, representing the Institute in its relation to competitions generally. This committee advises the sub-committees and directs their work and they report to it.

(*b*) A sub-committee for the territory of each Chapter, representing the Institute in its relation to competitions for work to be erected within such territory.

The President of the Chapter is *ex-officio* chairman of the sub-committee, the other members of which he appoints. The sub-committees derive their authority from the Institute and not from the Chapters.

An appeal from the decision of a sub-committee may be made to the Standing Committee. The Standing Committee may approve, modify or annul the decision of a sub-committee.

(18) *The Institute's Approval of the Program.*—The approval of the Institute is not given to a program unless it meet the following essential conditions:

(*a*) That there be a professional adviser.

(*b*) That the competition be of one of the forms described in Article 3.

(c) That the program contain an Agreement and Conditions of Contract between Architect and Owner in conformity with those printed in the Appendix of this circular, that it in-

clude no provisions at variance therewith, that it contain terms of payments in accord with good practice, and that it specifically set forth the nature of expert engineering services for which the architect will be reimbursed.

(*d*) That the program make provision for a jury of at least three persons.

(*e*) That the program conform in all particulars to the spirit of this circular.

When the program meets the above essential conditions, the approval of the Institute may be given to it by the sub-committee for the territory in which the work is to be erected, or if there be no sub-committee for that territory, then by the Standing Committee on Competitions.

If, for legal or other reasons, the Standing Committee deem that deviations from the essential conditions are justified, it may give the approval of the Institute to a program containing such deviations. Power to give approval in such cases is, however, vested only in the Standing Committee.

The Professional Adviser, when duly authorized in writing by the proper committee, may print the Institute's approval as a part of the program or otherwise communicate it to those invited to compete.

COMPETITIONS NOT APPROVED BY THE INSTITUTE

As only about one in eight architects of this country, and very few in Canada belong to the Institute, there is in some quarters objection to the Institute competition programs, especially the requirements that judges must be members of the Institute, and that Institute members may not participate in competitions the programs of which are not officially approved by the Institute. Also the selection of a jury of three, and other features, involve a burden of expense very few owners or boards are willing to pay, except in the case of buildings of monumental character, or of enormous cost. In such cases programs similar to that of the Institute, but modified in these particulars, may be used with satisfactory results, but of course Institute members in such cases will presumably not compete if invited, and competitors will have to be selected among architects not in the Institute.

THE SCHOOL ROOM

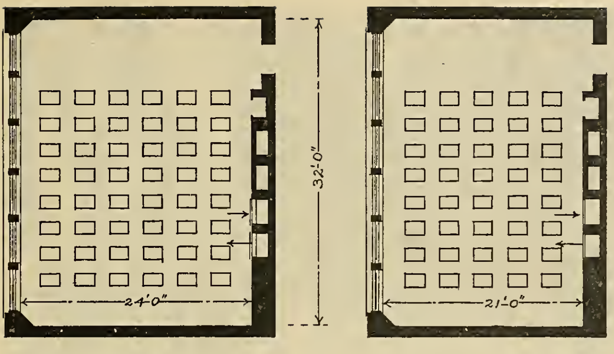
The controlling elements in planning a school building are the class rooms and the communications, the former being, of course, the fundamental unit in every school house design. Experience demonstrates that for the utmost efficiency a school room in an elementary building should not seat more than forty pupils, but in high schools, the work being done largely by lectures, no definite limit can be placed upon the seating capacity of rooms.

SIZE OF ROOMS

In school rooms each pupil has a desk. Under ideal conditions the room should be proportioned to allow 20 square feet of floor space and 260 cubic feet of volume for each pupil, but under no conditions should these figures be less than 15 square feet of floor space and 200 cubic feet of volume per pupil. It is almost universal practice to make school rooms slightly oblong with the teacher's desk at one end of the room, in the proportion of 24 feet by 30 feet and 25 feet by 32 feet, etc., with ceiling heights of not less than 12 feet or more than 14 feet. Primary school rooms should not be made smaller than other rooms in elementary buildings because activity is absolutely vital in small children, and the rooms should be ample in size to provide opportunity for much physical exercise, outside of net seating space.

LIGHTING

Some architects have resorted to the use of prismatic glass in lighting school rooms producing a glare annoying to both teachers and pupils, but under ordinary conditions of lighting it may be stated emphatically that the school room cannot be too well lighted. The writers on school hygiene, and the laws of different states vary somewhat, but there is substantial agreement



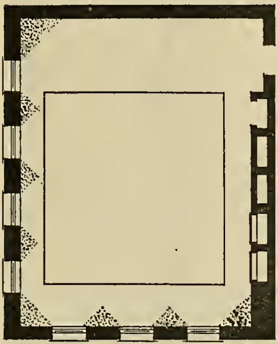


FIG A

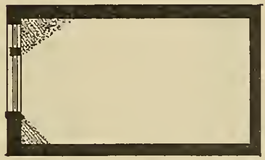


FIG B

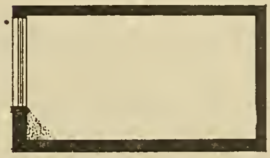


FIG C

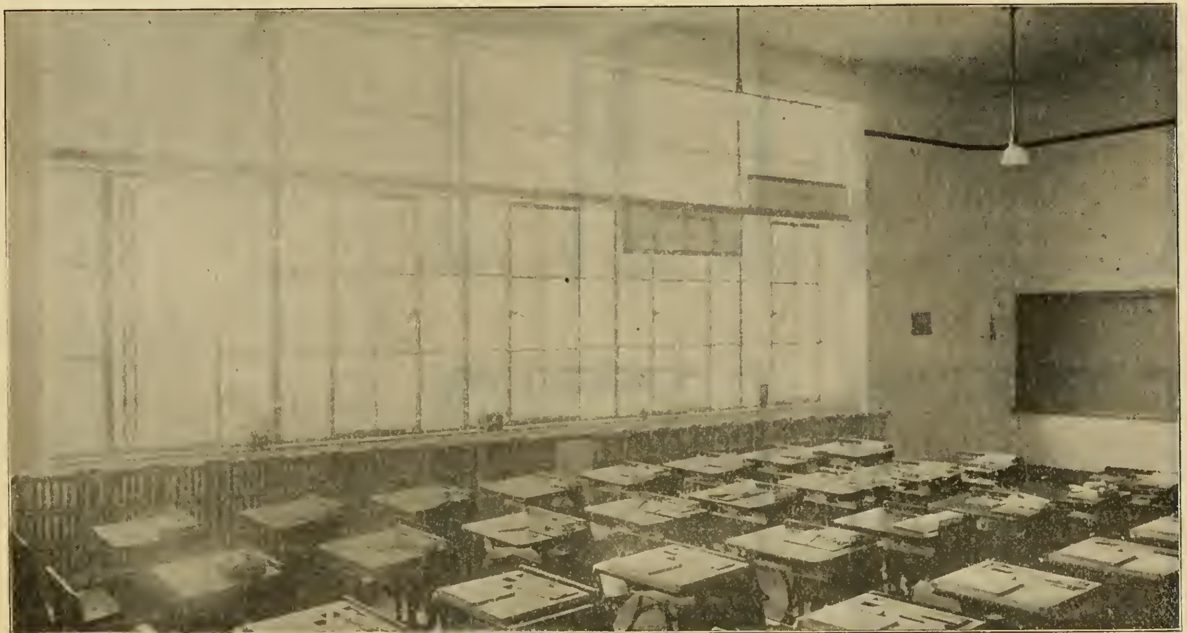
LIGHTING AND SEATING OF SCHOOL ROOMS.

The upper drawings show ideal designs for school rooms, one to seat 48 and the other 40 pupils. Dimensions given, also the arrangement of windows, heat and vent flues, door, etc., correspond with the best present day practice. Some authorities insist upon two exits, and such should be the case in non-fireproof buildings.

Fig. A, illustrates imperfect lighting with dark spaces between windows and in corners.

Fig. B, is a vertical section through the school room, illustrating the light shut out near ceiling by transom bars and fancy top windows.

Fig. C, is a similar secton showing correct locatton of windows with reference to floor and ceiling.



An excellent example of perfect lighting for a school room. Obscure glass used. Montgomery School, Newark, N. J.

that the amount of transparent glass surface admitting light to school rooms should in no case be less than one-fifth of the floor space of the room, while the laws of some states require one-fourth of the floor space in actual glass area. In rooms with ceilings 13 feet or more in height it is easily possible to secure even a higher ratio of glass than last stated and such opportunities should never be neglected. Care should also be observed to give rooms with a northern or poorly lighted exposure sufficient added glass surface to furnish the room with an abundance of light. As a rule, the use of prismatic glass should be permitted only in school rooms having obstructed sky lines, or dark exposure, and should be carefully shaded when the lighting justifies it.

DIRECTION OF LIGHT

There is now practically no dissent from the opinion that the proper method of lighting a school room is from the left side of the pupils, and that if it is necessary to admit light in any other side of the room it must be at the rear of the pupils. It is, of course, out of the question to admit light from in front of the pupils, as the light shining directly into their eyes would produce immediate and serious results. It is also very bad practice to admit light from the right of pupils because the great majority of children are right-handed and thus could not work at writing without casting a shadow thereon by the hand. When windows are placed in the rear of the pupils, even though the pupils themselves may not be injured by such an arrangement, the teachers are compelled to face the light almost continually, thus entailing risk of serious injury to their eyes. Further, when light comes from more than one direction into a school room the conflicting lights are almost certain to cause shiny places to appear on the blackboards, and the corners of the room between the walls containing windows are too dark for use as blackboard spaces. Rooms lighted from one side only have a constant light on all portions of the walls, no shiny spots on blackboards and no dark corners. Thus it will be seen that there are some objections to

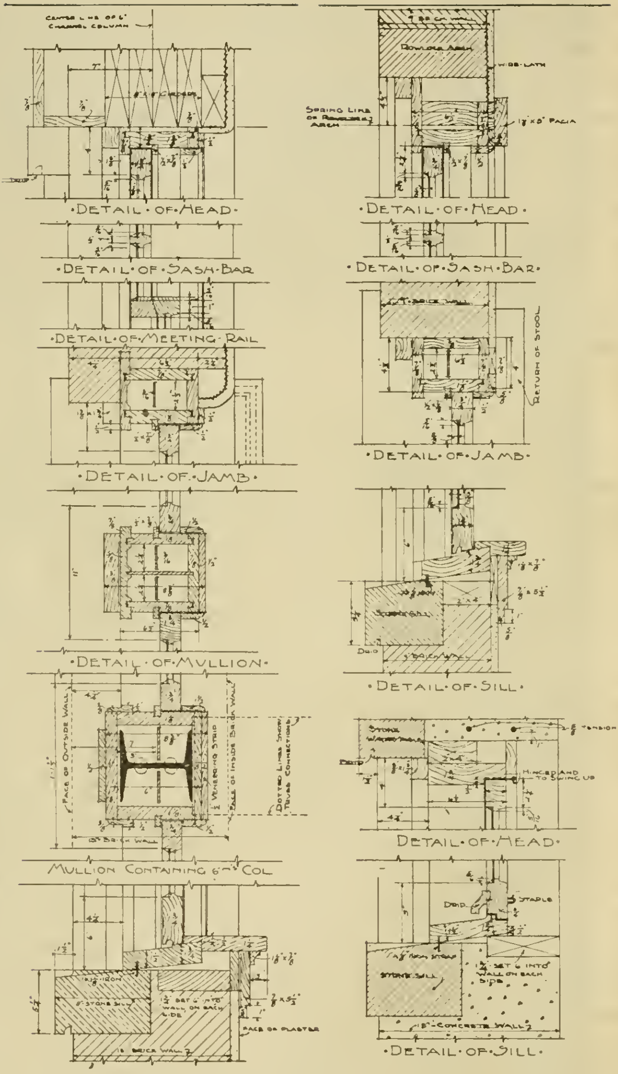


FIG. 2. WINDOW DETAILS

all lighting schemes except the one in which the light is brought from the left of the pupils, to which no reasonable objections can be stated.

THE DESIGN OF WINDOWS

Windows in school rooms should always extend as near the ceiling as possible. It is said that actual tests show that the upper one-fourth of windows furnish one-third of the effective light coming through the entire window. It is therefore obvious that windows with transoms at the top, and windows having arches and fancy tops seriously decrease the amount of light which is admitted to school rooms and should never be used in school buildings. The windows in school rooms should also be set with the least possible space between them, large mullions being carefully avoided, as these cause deep shadows producing alternate zones of light and shadow, which are annoying and injurious to the eyes. Window sills in school rooms are usually set at least three feet up from the floor.

FINISH OF WALLS

The walls of school rooms should be finished smooth but without high gloss, and painted so that they may be washed down and thoroughly cleaned as often as desired. There is general unanimity of preference for greenish tints in the decoration of school rooms, although other warm tints are used, particularly in rooms having sunless or cold exposures. Reds, yellows, blues and grays,—except grays of an olive tint,—should be avoided. The paint used should have no gloss but should dry flat. The ceilings may be made white or of a lighter tint than is used for the side walls.

WINDOW SHADES

Window shades in school rooms should be opaque. In case it is necessary to have the color of the shade exposed to the outside some particular tint to match the color of the building,

duplex shades should be used so that the inside surface may be of somewhat the same tint as that used on the walls or a trifle darker. Window shades should be hung on adjustable rollers so that the entire shade, roller included, may be removed to any part of the window desired. Venetian blinds should never be used in the school room, if for no other reason than because they are unsanitary.

BLACKBOARDS

Slate blackboards are much to be preferred over any other sort, but several brands of artificial blackboard can be obtained which are practically satisfactory and produce excellent results. In elementary school buildings as much blackboard as possible should be provided in every room. The height of blackboards from the floors should be as follows: Primary grades, 20 inches; intermediate grades, 22 inches; grammer grades, 26 inches and none over 30 inches. Backboards should be at least 3 feet 6 inches high, and 4 feet is better. All blackboards should have a chalk trough at the bottom at least 3 inches wide containing a woven wire cover ¼ inch mesh, easily removable. The trough may also well be furnished with cleanout holes in which the chalk dust may be brushed and removed by proper receptacles. In many of the better class of buildings mechanical means are provided for removing this refuse. Hooks should also be provided on the under side of chalk troughs to receive rulers or yard sticks, and in primary and intermediate grades a shelf may be provided over blackboards to receive pictures, drawings and art objects, although this shelf is a dust catcher and other provisions for pictures, etc., is preferred.

DOORS

Each school room should be provided with at least one door 40 inches to 44 inches wide near the teacher's end of the room, and where finances will admit, the door should be glazed with plate glass, the lower half of which is chipped. Transoms may be used with the doors if desired, although in all buildings

in which mechanical ventilating apparatus is installed the transoms should be made stationary and serve only for an architectural effect or for increased light in corridors, etc.

OTHER CONVENIENCES OF THE SCHOOL ROOM

Every school room should contain a small closet for the personal use of the teacher, having sufficient space for the storage of her wraps and personal effects. It should be made large enough to contain a limited number of books such as may be kept at the school room for reading to pupils, etc. Platforms for teachers' desks are but little used and are only provided upon special request to meet specific conditions.

PICTURE MOLDING

Every school room should be provided with picture molding, as well as the principal corridors. The best picture mold for the rooms is the "Outersite" mold manufactured by the Union Metal Corner Co., Boston, Mass. This molding consists of galvanized iron to be attached to the walls before any plastering is done. When the plastering is put on the walls, nothing is seen of the mold except an opening about 1/8 inch wide in which the picture

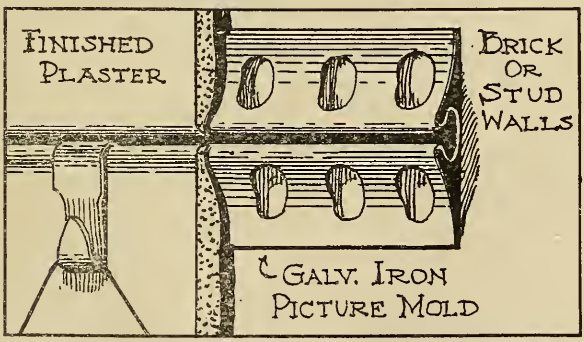


FIG. 3.

View of Outersite Galvanized Iron Picture Molding

hangers may be inserted. This molding is not only strong, cheap and easily put up, but has the ideal advantage of being dust proof.

DECORATION OF SCHOOL ROOMS

The decoration of school rooms with pictures is every year regarded with more favor. While there is no doubt that many school walls contain pictures of satisfactory quality, it is probably true that in many instances such decoration of rooms is subject to just criticism.

Perhaps the pictures are too small for the space, or inadequate in carrying power on account of having much fine detail which cannot be seen at a distance; or pictures that hang in balancing spaces are of widely different sizes, giving an unbalanced look to the decoration. Such errors, and many others

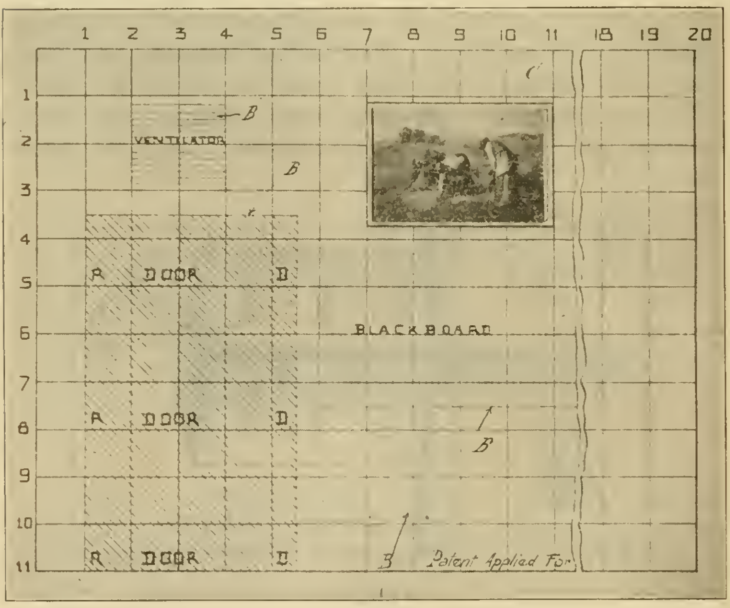


FIG. 4. SCHEME FOR SCHOOL ROOM DECORATION

have come about because no systematic plan for the decoration of the room has been made at the start and the work has been carried on in a haphazard way.

There is no sound reason why plans for the decoration of a school room should not be devised in advance,—the spaces on walls considered, and the pictures selected with due attention to appropriateness to grade and studies taught in the room.

To meet this necessity a simple method of making plans for systematic school room decoration has been devised by the Elson Art Publication Co., Inc., of Belmont, Mass.

One such plan is shown in illustration on page 32. The scale sheets, with illustrations of pictures made to the same scale as the sheets, may be obtained from them. With this material, and the directions accompanying them, anyone can make the necessary plans with very little labor and without any expert knowledge of plan making.

THE SCHOOL BUILDING

GENERAL CHARACTER

A principle of architecture generally recognized is that a building should express by its general character the purpose for which it is erected, a principle very applicable to school buildings because it is so easy to comply with this requirement. The school building should be simple, dignified and plain and should be built of the most enduring materials procurable; first, because this contributes to its safety, permanence and endurance, and second, because the true character of the building will be best expressed through such materials. If at all possible, not only the exterior but the interior walls should be made of masonry construction. The building should be as near absolutely fireproof as possible and in case it is more than one story in height, it will be found that the difference in percentage of cost between a combustible building and a fireproof building, at the present time, is very small indeed. There is practically no dissent at the present time from the view that in every school building the corridors, stairways, entrances, etc., must be absolutely fireproof and that emergency exits, also fireproof, must be provided. To insist upon less severe requirements means to endanger the lives of pupils for a very niggardly saving of expense which can be justified upon no grounds whatever.

EDUCATIONAL PLAN

The design of school buildings, particularly high schools, is of course dependent upon the educational policy employed in the city where the building is located. The educational methods in grade schools throughout the United States are practically uniform, but in high schools there are at least two well defined plans which differ from each other very widely. The first plan is to so arrange the building that all of the pupils are at all

times separated into classes and occupying class rooms. At the end of the recitation period, or study period, as the case may be, the pupils move from the class rooms in which they have been during the last period to the room which they are to occupy during the next period.

In the second educational scheme, large study rooms are provided in which pupils who are not actually engaged in recitations are required to spend their time, and at the end of the various periods the pupils leave the study rooms to go to their various recitation rooms, and the pupils who have been in recitation return to the study rooms. In some schools separate study rooms are required for each class, one for freshmen, one for sophomores, etc. In other buildings one study room is provided for freshmen and sophomores and a second room for juniors and seniors. The adherents of both of these general schemes are pronounced in favor of their own particular arrangement, and undoubtedly there are advantages on both sides. In general, however, it may be said that, particularly in states like Ohio, where the laws require 20 square feet of floor space for each high school pupil, the study rooms for Ohio high schools must be of relatively enormous size, and there is sure to be considerable waste space in the building because of the fact that it is almost impossible to estimate accurately the proper size of the study rooms. Owing to this fact, the common practice is to make study rooms larger than need be, resulting usually in a considerable amount of waste space. In the plan where the pupils are at all times kept in separate class rooms there need be no waste space at all, as the class rooms are provided sufficient in number and size to accommodate the entire enrollment of the school.

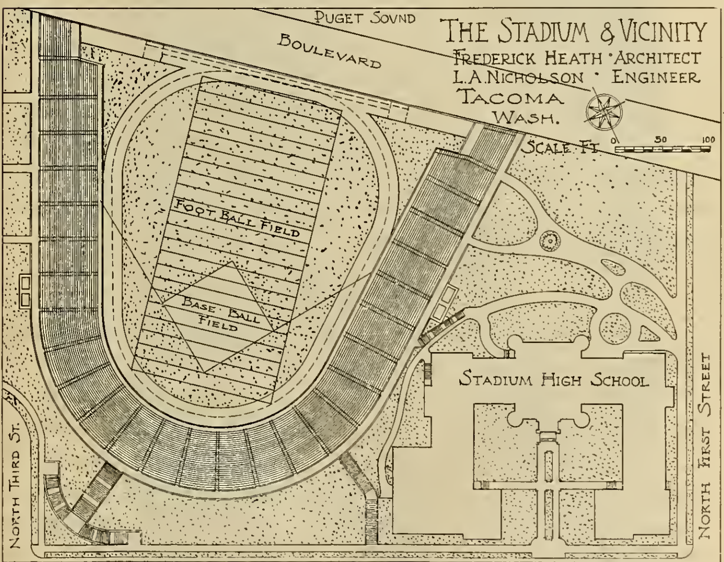
On the other hand, the study room scheme has an economic advantage in one respect,—one teacher is able in the large room to supervise during the study period the maximum number of pupils. As this question is one of educational administration it is only necessary to be referred to here for its bearing on the architectural design of the building. No architect can intel-

School Gardens, Collinwood, Ohio. On the site of the building destroyed by fire, with such terrible loss of life.

ligently design a high school building until he is personally familiar with the educational methods to be employed in the building itself.

THE BUILDING SITE

There are but few cities in the United States in which it is not possible to obtain abundance of ground for school buildings in any part of the city. In the cities referred to the conditions must, of course, be met as they exist and fortunately our largest cities are producing admirable results even under the conditions referred to. Everywhere else suitable grounds may be obtained for any building to be erected, and the latter should be set as far from streets and adjoining buildings as possible, thus ensuring (1) an abundance of free air to circulate all about it, (2) clear light so that every room in the building may be properly lighted, and (3) the absence of dust and noise. Various rules have been laid down for the proper distance to be



One of the most magnificent school sites in the world.

left between a school building and any adjoining buildings, some maintaining that a line drawn from the foot of the wall of the school building to the top of the nearest structure should cover an angle not more than 30 degrees with the horizontal. The Ohio law allows 45 degrees. In any case it is absolutely essential that play grounds surrounding schools should be ample and well cared for.

PLAY GROUNDS

Many teachers connected with the play ground associations of the large cities are emphatic in their statements that properly conducted play grounds are powerful factors in the moral and mental development of school children. It is a common saying that Americans, as a people, take life too seriously, and the utmost care should be exercised to prevent this condition in school children by definite provisions for recreation, especially as the curriculum in our city schools is already exacting and becoming more so.

These Playground Associations are doing wonderful work in developing public sentiment in favor of systematic playground work and facilities; these playgrounds serving as social centers, open to those who need them, at all hours and the year around. School gardens, both for agriculture and horticulture are also features of many recent school plants. We are not here concerned with these features except in so far as they affect school buildings and equipment.

ORIENTATION

Owing to the fact that streets in many of our cities run North and South or East and West, it is usually necessary to set the buildings parallel with the streets, but this arrangement is not as good as that which admits of setting the school building at an angle with the North and South direction so that in all seasons of the year every room in the building will at some time during the day receive direct sunlight. Medical authorities agree that the spread of many forms of disease can be arrested by an abundance of sunlight. While trees beautify the surroundings

Washburne School, facing Stanford Park, Chicago, Ills. This civic center includes the school building, play grounds, field house, branch public library and swimming pool.

of the school building, care should be exercised not to have them close enough to the building to interfere with the perfect lighting of every room.

Where it is necessary to arrange school buildings parallel with North and South lines, it is wise, if possible, to have most of the windows on the East and West facades, thus avoiding a part of the heat and glare of direct Southern exposure.

FOUNDATIONS AND BASEMENT

The foundation of every school building should be abundantly waterproofed, an item in building construction which until recent years has not received very great attention, but which now is so thoroughly worked out that the basement may easily be made moisture proof at slight expense. In the smaller school buildings of the country, basement stories are usually made use of not only for heating equipment, but for play rooms, etc., and in such cases it is only necessary to provide that all such rooms shall be clean, well lighted and hygenic in character. But in the larger and better class of buildings, economic considerations and the desire to avoid going up in the air with several stories, often renders it advisable to make use of the basement for actual school purposes, in which case every rule which applies to the proper design of school rooms in any other story applies also to the basement.

NUMBER OF STORIES

There has been a remarkable change in public sentiment in recent years regarding the number of stories admissible in a properly designed school building, and it may safely be said that there is a strong sentiment against having more than two stories above the basement, except where necessity demands it. In many cases the basement story is made the same height as other stories, the basement floor being placed at the ground level or a very slight distance below it. In some of our largest cities where suitable sites cannot be procured, it becomes absolutely necessary to erect buildings three and even more stories in height, but

such design is inexcusable under other conditions, and indeed some of the buildings referred to contain elevators for the use of pupils. There can be no debating the proposition that, on hygienic grounds, school buildings should not exceed two stories above basement unless elevators are provided for the use of at least female pupils. Serious troubles may be brought upon young growing girls by too frequent climbing of stairs and there is, of course, an added danger in case of fire or panic.

ATTIC

The attic of a school building should be floored with a tight floor, not only because of the convenience of access to all parts of the building, but also to prevent an undue radiation of heat from the school rooms in winter and the super-heating of school rooms in the upper story in warm weather. In any case the greatest care must be exercised in all parts of the attic to provide against fire and to give the attic space suitable ventilation.

ROOFS

It will hardly be denied that there is a substantial preference in favor of flat roofs for school buildings. While it can not be denied that many beautiful effects are obtained by the use of pitched roofs—especially in cases where tile and other ornamental coverings are used, it must be granted that money so expended can often be used to better advantage elsewhere in the building. It is a well-known fact that flat roofs are not only more economically constructed, but seldom cause terrible leakage or expense for repairs. In the larger cities they are also used as playgrounds.

ENTRANCES AND EXITS

No school building should be constructed having less than two large entrances and exits, and all entrances and exits should be fireproofed. It is perhaps safe to say that no school building can have too liberal provision of entrances and exits. No set rule can be laid down for the dimensions for such portions of

Example of fireproof "smoke partitions," between stairways and corridors, required by the Ohio Code.

the building without knowing the magnitude and capacity of the building in which they occur, but if builders are liberal to the point of extravagance in this regard it must be remembered that they are thereby only adding to the safety of the building. Steps entering school buildings should always be placed on the inside of the building. All vestibules should be large and roomy to provide shelter for the children and to prevent the interior corridors from direct contact with the outside weather. Every entrance should have a suitable lobby with inner and outer doors to protect the interior of the building from draughts and storm. All vestibule corridors and stairways in every school building should be carefully and abundantly lighted by direct light from outdoors, and long narrow corridors in every case should be avoided. In many of the states, laws now require that all doors throughout public buildings shall open outward, and in any case this rule should be adhered to in school buildings.

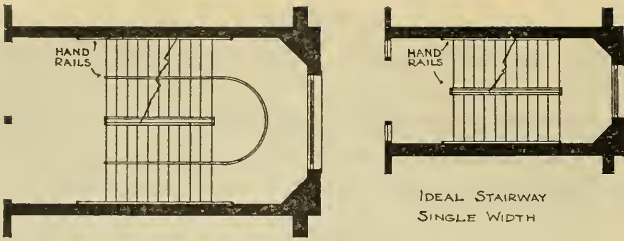
CORRIDORS

Main corridors should be at least 8 feet wide and in buildings of eight rooms or larger, 10 feet should be the minimum width. Secondary corridors may be eight feet or wider, and all corridors should be as straight and as perfectly lighted as possible. See the Boston requirements, and the Ohio Code.

STAIRWAYS

The simplest standards of common sense dictate that every school building should contain at least two stairways, and there is a growing demand that all stairways must be fireproof, but it is not enough simply to require that there be two stairways. It must also be required that they be so placed in the building that in case one becomes stopped up, because of fire or panic, the other stairway will not be affected thereby. It is the height of bad design to have the two stairways terminate in one hall in the center of the building. In case the building is more than two stories high both stairways should be carried from the bottom of the building to the top. Whether the stairways are fireproof or not, they should be enclosed in absolutely fireproof masonry walls from top to bottom, and in non-fireproof buildings there should be direct access from the stairway enclosure to the ground, regardless of the connections between the stairways and the interior portions of the building. Large windows should also be provided on the stair landings, being accessible from the landings themselves, thus reducing the risk of panic, and crowding in the stairways, not only by providing an abundance of light but a means of egress from the building in case of emergency. Circular or angle steps should never be permitted in a school building under any circumstances.

In case stairways are built fireproof, they should be constructed of iron or steel, with treads of slate, marble or cement, or treads of cast iron, containing an inserted tread of lead similar to the Mason Safety tread. A simple form of iron or steel stairway can be constructed at a very slight increase in cost over the ordinary type of stairway, all items considered.



IDEAL STAIRWAY
SINGLE WIDTH

IDEAL STAIRWAY
DOUBLE WIDTH

DETAILS OF STAIRWAYS

FIG. 5.

There is considerable difference of opinion regarding the correct width for stairways, but there is comparative agreement that the maximum width of steps between railings should not exceed five feet. In other words, if a flight of stairs must be 8 or 10 feet in width, it should be separated in the middle by a balustrade consisting of an iron railing and screen between the railings and steps, thus making an equivalent of two stairways in one. In case this arrangement is followed an iron rail should continue around the platform as shown in figure (5). It is well to avoid more than two runs of steps between one floor and the next, and never to permit a single stair run without a landing. In the best design the two runs should be in reverse directions, and so designed that there is no opening or well left between the runs. The landings of stairways and the spaces at bottom and top of same should always be liberal, and many authorities recommend the filling out of square corners as shown in figure (5). The height of risers in school stairways should never exceed 7 inches, and from 6 inches to 6½ inches is much better practice. See the Boston and Ohio Codes.

FLOORS

It is almost generally conceded that for finishing floors of school rooms maple is preferable to all other woods because of its toughness and the closeness of its grain. While it is not as hard as oak, yet the latter is much more objectionable because

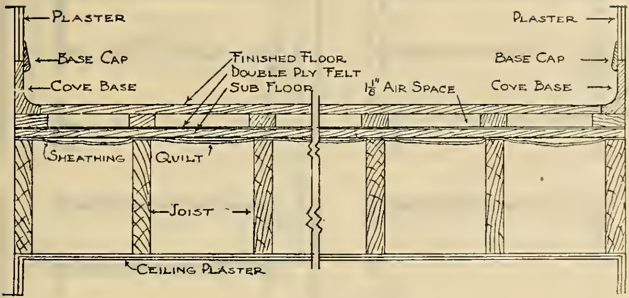


FIG. 6.

of its open grain. Rift sawed Georgia pine has also been used extensively for school room floors, but, in case the maple cannot be procured to advantage, the writer prefers to finish school room floors with plastic cement of which there are several first class brands on the market. These are especially fine for corridors and toilet rooms where money is not available for tile or marble. These cements are fireproof and do not produce any dust from the friction of human feet, such as is the case with ordinary cement floors. Further, seats or furniture may be fastened to the floor in same manner as on wood flooring and all cracks and unhygienic features are absolutely removed. But best of all, by the use of such materials for flooring, it is possible to make a cove and base continuous with the floor, as shown in figure (6), thus rendering the floor one of the sanitary features of the school cove and base continuous with the floor, as shown in figure (6), For soundproofing of floors in non-fireproof buildings the writer usually follows the plan indicated in figure (6), from which it will be seen that an air space is provided between the sub-floor and finishing floor, which with an abundance of deadening felt should be almost impervious to the passage of ordinary school room sounds.

PLASTERING

The plastering used in school buildings should be what is known as hard or cement plaster finished with smooth white coat

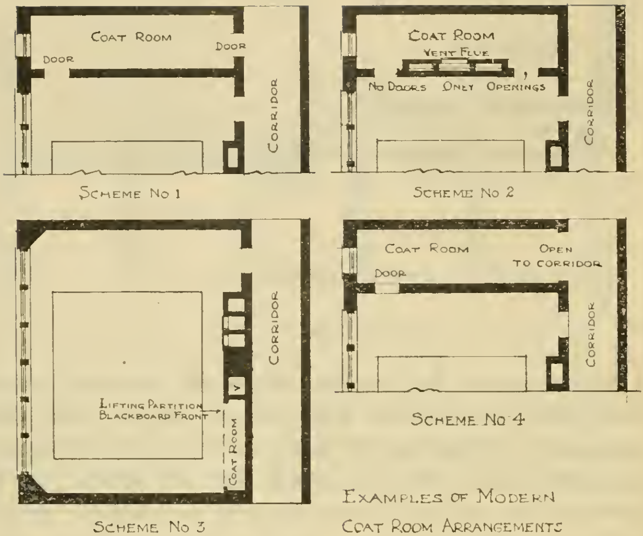


FIG. 7.

Figure 7 illustrates four coat room schemes all in common use. Advantages are claimed for each one. In fireproof buildings perhaps scheme No. 3 is most used because of economy. Of the others, the author prefers scheme No. 2.

to be decorated with paint. Corners of walls and ceilings should be concave and all fancy cornices, moldings, etc., should be avoided. No school surfaces should be covered with wall paper or finished with a rough surface which would prevent washing or wiping down the walls at frequent periods during the school year, if advisable.

WAINSCOTING

Wainscoting should never be used in a school building unless money enough is available to render it possible to use glazed brick or tile. Wainscoting of wood is unsanitary, soon becomes unsightly and also increases fire risk.

COAT ROOMS

There is perhaps no feature of school design upon which there is, at the present day, a greater divergence of opinion than the question of coat rooms. It is generally conceded that in

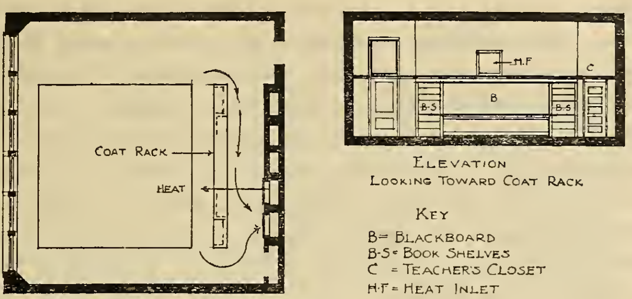


FIG. 8.

Figure 8 illustrates a type of coat closet, which is hardly a coat room, but is more like a coat rack or wardrobe. It consists of a rack or framework about eight feet high, erected about five feet away from the wall containing heat and vent registers.

The back or wall side of this rack contains hooks for clothing, but no doors or covering for same. The front or room side of the rack may be covered with blackboard, may contain shelves for books, or both blackboard and shelves as shown.

Admirers of this scheme claim many advantages for it, but chiefly that it enables teachers to have surveillance of the coat room space without leaving the school room. To offset this and other advantages claimed, however, it must be granted that the scheme is unsightly, unsanitary, wasteful of space and more expensive than any other coat hanging scheme above described.

primary and grammar school buildings the coat room should be connected with the school room; but some authorities hold that there should be tight doors between coat rooms and school rooms, while other authorities contend that there should be only openings between the two. These people hold that the foul air, in finding its way to the vent stacks, should proceed from the school room into the coat room and thence out through the vents to the roof. Under this plan there is no access direct from the coat room to the corridor. Other authorities prefer connection between the coat room and corridor, and a separate ventilating system for the coat rooms from that which serves the school rooms. Still other authorities recommend a system of large closets in connection with the school rooms themselves, as shown in scheme (3), the door of the coat closet consisting of a rolling or sliding partition which is lowered to the floor after the wraps are in place, this partition containing vent registers at the

bottom. In any case it may be said that the minimum size for a coat room adjoining a standard class room should be 125 square feet floor space and that coat room must, if possible, be well lighted and in every case thoroughly ventilated. In buildings above the grammer grades the almost universal practice, at the present day, is to provide separate coat rooms not located in connection with the school rooms which they serve, and in the better buildings lockers are provided for the use of each pupil, the entire system of coat rooms being included in the system of forced ventilation in the building.

TYPES OF SCHOOL BUILDINGS

In villages and in many cities below the first class, all the grades including high school have been provided for in one building. Just now however, there is a strong movement toward housing schools in buildings designed and equipped for the specialized work of each school. Even towns and villages are now erecting primary, intermediate, technical and high schools of admirable types and complete equipment. Examples of all these types are found in the illustrated section of this work.

The growth of manual training schools is now phenomenal. It is only about thirty-five years since the first such school was established by the city of St. Louis, and that in connection with Washington University. The McKinley High School, St. Louis, erected in 1902, is probably the earliest type of our present day technical high schools. Today magnificent institutions of this type are found in all sections of the country, some of the best of which are illustrated in the following pages.

Methods of instruction in all secondary schools have been profoundly influenced, of late years, toward the natural sciences, and college entrance requirements have been extended to include laboratory work in these sciences. No longer is education wholly a text book affair. Now the student is put in touch with first-hand materials of knowledge, and guided and stimulated to make over these crude facts into real practical demonstrated knowledge for himself.

Following out this tendency, there is a very new movement —probably the most recent and striking in the public educational world—for the establishment of Junior high schools, at first attempted merely to relieve congestion in high schools and eighth grades, but finding almost instant favor in many localities.

The Junior high school is merely a school comprising the first year high school, or ninth grade, the eighth grade and sometimes the seventh grade in a separate institution or classification; housed by itself, equipped like a high school, and the system of instruction modeled on high school lines. In many cities of the second class, having but one central high school, the Junior high school offers an admirable plan for extending the high school training over a much wider field without crowding in either branch of the work.

Prof. Edward L. Thorndyke of Columbia University, is authority for the statement that out of 100 average pupils who enter public schools, 90 finish the fourth year, 81 the fifth year, 68 the sixth year, 54 the seventh year, 40 the eighth year, 27 the first year high school, 17 the second year, 12 the third year, and only 8 the fourth year of high school. These figures were based on official data in New England cities of 25,000 or more inhabitants. Only 40 per cent finished the eighth grade, and only eight per cent finished the high school. Assuming these figures reasonably correct with reference to the whole country, it is evident that the Junior high school will bring high school facilities and training to a largely increased percentage of pupils, and undoubtedly also serve to attract many more to continue through the senior high school to completition. All things considered it would seem that the Junior high school is here to stay.

All of the movements above briefly described, give rise to the insistent demand for school buildings of highly specialized types, designed and equipped with all the intelligence and care of a watch factory or a great railway terminal. Many of the best of such buildings re illustrated in the following pages, but a separate and much more detailed work would be needed to handle this one subject adequately.

Auditorium of Franklin High School, Seattle, Wash. Equipped as a study room.

SPECIAL ROOMS

APPARATUS ROOMS

In every school building to contain any considerable quantity of apparatus such as high school buildings, suitable rooms should be provided for the storage and care of such apparatus, and in proportion to the value of the apparatus is it important that such rooms should be fire-proof and fool-proof. They should be provided with suitable cases in which the apparatus may be protected from dust and interference, the cases being furnished with lock and key so as to be kept under the control of the head of the department at all times. It is always desirable to have apparatus rooms connected with physical and chemical laboratories, and the floor area of same should equal about one-fourth to one-third that of the laboratory.

ASTRONOMY ROOM

High schools which are equipped with observatories should have a small room adjacent to the observatory which may be heated in cold weather, as the observatory itself is always cold. This room may also contain cases for small instruments.

ASSEMBLY ROOMS OR AUDITORIUMS

Two different systems are used in the designing of American high school buildings with regard to Assembly Halls. In some, especially those located in small cities and towns, the Assembly Hall is intended for use only as a public Auditorium, in which ample stage facilities are necessary together with provision for stereopticon entertainments, and in which audiences of from 800 to 1500 persons may be seated. In other buildings the Assembly Hall partakes more of the nature of a study room, being seated with desks and intended for the use of pupils only. In still other buildings the stage equipment is provided even

School Building at Newark, N. J., showing open air room (upper right hand corner) for tubercular pupils.

Interior of open air school room, Montgomery School, Newark, N. J.

though the room be seated with desks for study purposes, and in such schools the Assembly Hall is used not only for a study room but also for such literary and chapel exercises as are conducted for or by the pupils. In either of the latter schemes the hall must be large enough to accommodate all pupils of that building at one sitting, this end being accomplished by different means in different buildings.

Under the present heading, reference is had only to the room intended as an auditorium in which no desks are provided and the following are the important items regarding same. Such rooms should never be placed higher than the second floor of a building and never lower than the first floor, provided the basement floor is below the ground, a "ground floor" Assembly Hall being favored by all authorities and required by law in some states. If galleries are used, entrance to the same may be had from the second floor. Auditoriums in school buildings should be provided with a stage as high as possible and at least 15 feet in depth behind the curtain and should be equipped with a rigging loft, dressing rooms and a small amount of drop scenery and curtains, much the same as may be found in theaters. The larger and more elaborate the Auditorium, the more liberal and better equipped should be the stage. The floors of school Auditoriums are almost invariably made level, or at least with very slight incline, no attempt being made to copy theaters in this regard.

Direct current outlet contained in an iron box should be located in gallery to supply light for lanterns, and a white curtain may well be included in the equipment of the stage for the same purpose. An ample switchboard should be provided on the stage by which every light in the Auditorium may be controlled at will, both separately and as a whole, and the stage should be lighted with foot lights, borders, etc., in much the same manner as the stage of a small theatre, all being controlled from the switchboard.

Means of exit must be provided directly from the Auditorium to the ground outside regardless of exits provided inside

of the building, and no Auditorium should be placed high enough above ground to render this impossible.

BALANCE ROOM

In the larger and more complete high schools a small room is provided in connection with physical laboratory in which delicate balances are kept in cases for experimental purposes. These rooms need not be larger than 50 square feet area.

BATH ROOMS

Every school building containing a gymnasium should have shower baths, arranged in separate groups for the exclusive use of each sex. Probably the best type bath stall is the double stall arrangement illustrated in chapter on Sanitation, consisting of an outer stall with corner seat to serve as dressing room, and an inner stall containing the shower. A curtain at the outside door renders both stalls private, so the bather is protected until rubbed down and robed. The number of bath rooms depends of course on the size of the school enrollment, and the space available. One bath for each fifty pupils is a fair equipment.

Bath rooms should be in immediate communication with the gymnasium, locker rooms and toilet rooms.

BIOLOGICAL ROOMS

In the better high schools biological rooms consist of a pupil's laboratory, a private laboratory for the instructor, a dark room and apparatus room all of which are described under their several headings below. The biological laboratory should be abundantly lighted and equipped with cabinet desks containing a drawer for each pupil having the use of such desk, also glass cases for specimens, and also containing suitable demonstration table, preferably with slate top, and instructor's desk. Equipment of private laboratory and apparatus room may be made as simple or elaborate as available finances will permit. The size of biological or other laboratories is dependent upon the number of pupils required to use them. If the building contains a conservatory it should adjoin the biological laboratory.

BICYCLE ROOM

In cities and towns where bicycles are used to any extent it is advantageous to have provision in school buildings for a bicycle room containing permanent bicycle racks, and a bicycle run from ground level down to the room. Such rooms should be provided with substantial locks.

BOARD ROOM

In many places it is necessary to provide rooms in the school building for the use of the Board of Education, the size of which should be proportioned to the number of members on the board. Such rooms should always be provided with private toilet rooms, and if possible a telephone closet and fireproof vault. If the Clerk of the Board is a permanent employe, who devotes his entire time to the work of the Board, an additional work room should be provided for his use having abundant light, access to the vault and toilets.

BOILER ROOM

The boiler room for school buildings should if possible always be located outside of the main building. In case this is impossible the floor above boiler room should be made both fireproof and heat-proof regardless of the construction of the balance of the building. Boiler rooms must always be at least twice the length of the boilers themselves to provide for cleaning flues, and in case fuel is also contained in the same room abundant provision must be made for storing same. No boiler room should be less than 12 ft. clear height and considerably more height is advisable.

BOTANICAL ROOMS

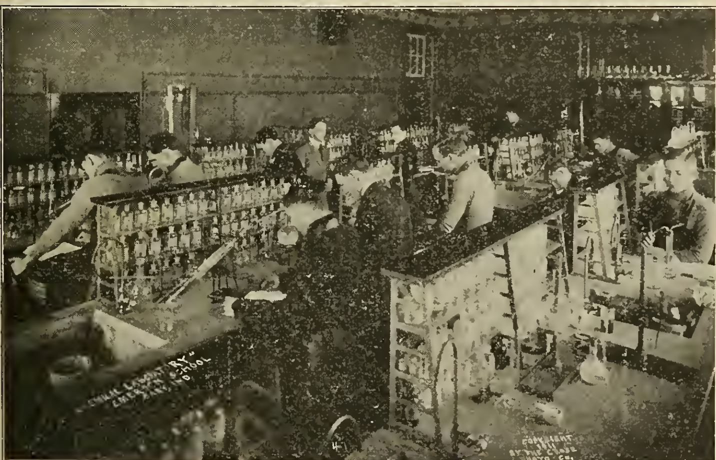
The botanical rooms may be practically the same as the biological rooms. In many high schools the same group of rooms are used for both subjects. It is very desirable to have a conservatory in connection with the botanical rooms.

BUSINESS DEPARTMENT

The Business Department in high schools should contain at least three rooms, one each for bookkeeping, shorthand and typewriting. Ordinarily the room for bookkeeping is made the size of an ordinary school room and the other two rooms about one-half this size. The rooms for shorthand and typewriting may be separated simply by a glass partition, and be so located that one instructor may oversee both rooms. The three rooms of this department should be well lighted, located *en suite*, and in the more elaborate buildings may also be supplied with an additional small room for the instructor's private use.

CHEMISTRY ROOMS

Rooms for the study of chemistry in high schools include lecture room, laboratory, apparatus room, balance room and dark room. The size of the lecture room and class-room is dependent on the number of students required to use them, and the other rooms proportioned thereto. The equipment of the laboratory may be as elaborate and complete as finances will admit, but in any case it is advisable to use work tables having closed



Chemical Laboratory, Emerson School, Gary, Ind. Copyright 1911, Crose Photo Co.

hoods which are connected with suction pipes under the floor and these, in turn, with vent risers in the walls leading to an exhaust fan by means of which all air in the laboratory may be drawn through the work tables and forced out doors; this method of ventilation preventing the escape of foul odors into the building. The chemical laboratory should also be provided with a floor drain readily accessible at all times.

CLERK'S OFFICE

The data for a clerk's office may be found under the head of Board Rooms.

COAL ROOM

Coal rooms should be located outside of building if possible but always in conjunction with boiler or furnace room. They should be large enough to contain not less than a half season's supply of coal, and if possible a supply for the full season.

COAT ROOMS

This topic is treated in conjunction with school rooms but as here employed refers to those rooms, in the larger high school buildings, which are centrally located and intended to contain the wraps for an entire floor or any other large number of pupils. Two systems prevail in this regard, one being the use of steel or other closed lockers, each pupil being provided with his own locker and the key thereto; and the other system consisting of open racks in which the wraps are allowed to hang on individual hooks and are kept under the espionage only of the janitor. The users of both systems seem to be satisfied, so that it is largely a matter of individual choice.

COMMERCIAL ROOMS

See paragraph on Business Rooms.

CONSERVATORY

In large and elaborate high schools a conservatory is provided in connection with the biological or botanical laboratory.

This is a room constructed all of glass, located on a sunny side of the building and so arranged with piping that it may be kept at any desired degree of temperature uniformly. It usually contains an aquarium and a counter-table under the windows constructed of slate and supported on brass pipe. It should be separated from the laboratory by a partition all of glass, and the frame work of the outside should be constructed in the same manner as the highest grade hot-houses, preferably of metal frame with glass filling.

DIRECTOR'S ROOM

In connection with large and complete gymnasiums, at least one and preferably two rooms should be provided for the personal use of the director, this room being connected with the gymnasium itself by a glass door or partition and being well lighted, although skylight will answer for this purpose.

DINING ROOM

In buildings containing departments of domestic science a small dining room is desirable in connection with the room in which cooking experiments are conducted. This room need not be large, say 180 square feet. It should have a dish cupboard.

Dining Room, Emerson School, Gary, Indiana.

DARK ROOMS

Dark rooms are considered one of the essentials of modern high school buildings to provide for photographic work. They may be very small—not over fifty square feet area—and should be provided with a sink, running water and two or three convenient shelves. The chief essential of these rooms is that they must be absolutely dark, be painted on the inside with dull black paint and be separated from any outside room by two doors or some other device which will render it impossible by accident, or otherwise, for any daylight to be admitted into the room while experiments are going on.

DOMESTIC SCIENCE

The department of domestic science in present day schools as a rule comprises two departments called by some domestic economy and domestic art, the former consisting of a department for the study of cooking and the latter for the study of sewing, etc. The room for domestic economy is much like a laboratory, and its size will be dependent upon the number of

Domestic Science Laboratory, Emerson School, Gary, Ind.

pupils to be accommodated, the work being done at specially designed tables which must be so disposed as to leave abundance of working room all around them. Provision must be made for carrying gas supplies to each table and plumbing supplies to each sink, and in addition, a general sink of liberal dimensions and preferably of slate or soapstone should also be provided. Ample provision must be made for cupboards for the storage of utensils, dishes, etc., and it is advisable if possible to provide for a small ice-box for the preservation of food supplies.

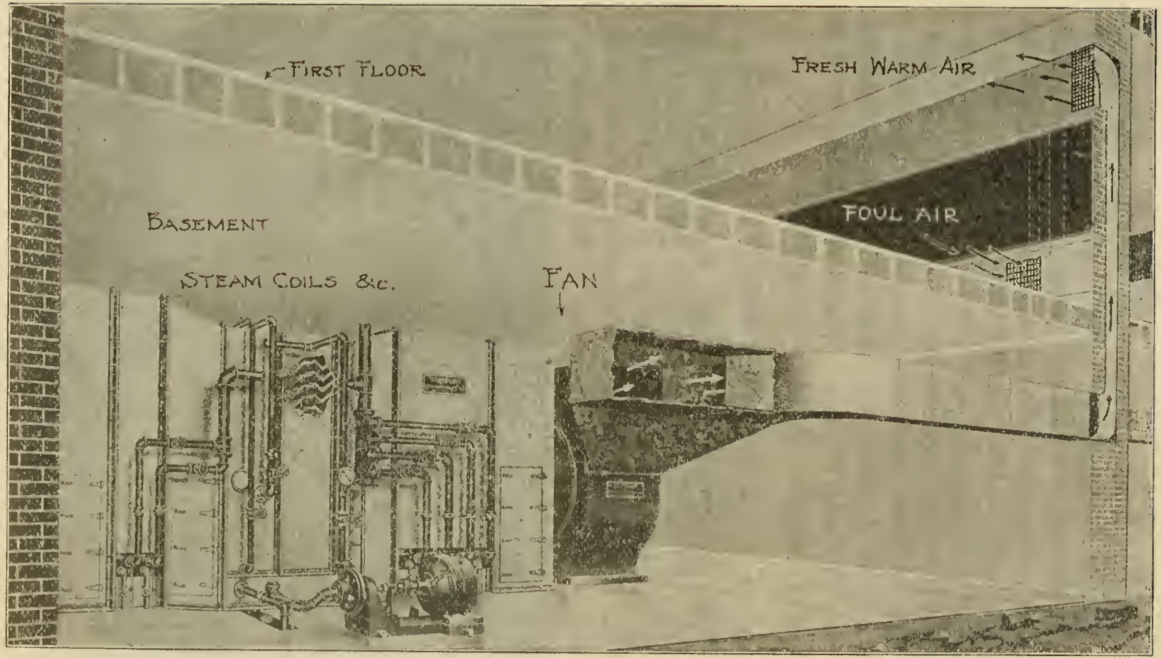
The room for domestic art or sewing seldom needs to be larger than the ordinary school room unit and in many buildings only half this area is ample. The chief requirement for this room is an abundance of light and ventilation.

DRAWING ROOMS

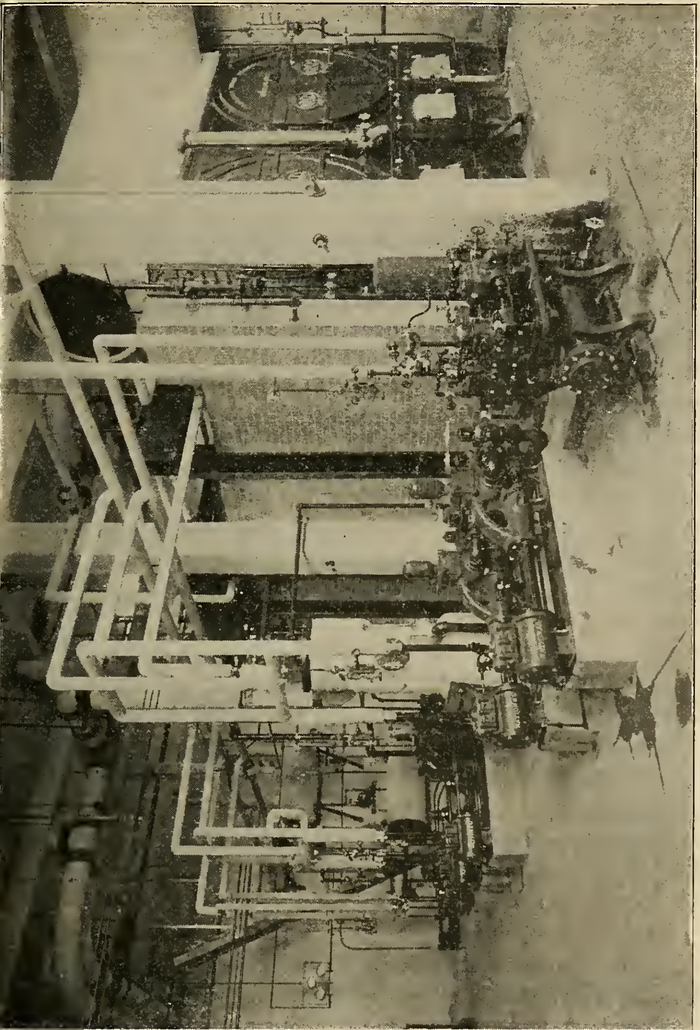
Every modern high school must make provision for both free-hand and mechanical drawing, and while not necessary, it is usually advisable that the rooms for these two departments shall be close together and communicating. A first requisite for drawing rooms in an abundance of light, preferably north light, but skylight is also acceptable, especially for free-hand drawing. Drawing rooms should contain cases for books, studies and models, a teacher's desk and abundant provision for drawing tables, easels and chairs or stools. The room for free-hand drawing should contain a shelf not less than 18 inches wide and about 2 feet 6 inches above the floor, and also a second shelf about 12 inches wide located 7 feet or 8 feet above the floor, both shelves extending clear around the room except where windows and doors are located. The wall space between these two shelves should be covered with Compo board or other soft material which will readily take thumb tacks, and the outside surface of same should then be covered with burlap of a neutral tint.

DRESSING ROOMS

Two, and preferably four small dressing rooms should be provided in connection with the stage of auditoriums or assem-



Drawing showing fan room design. Courtesy of The B. F. Sturtevant Co.



Boiler room and engine room, Franklin High School, Seattle, Wash.

bly halls, and, while it is not necessary, it is nevertheless advisable that these rooms should have outside light and ventilation and

stationary lavatory in each room. Gas lights should also be provided as well as electric lights. See Bath Rooms.

EMERGENCY ROOMS

See Rest Rooms.

ENGINE ROOM

In every building containing machinery, such as engines, dynamos, etc., a separate room or rooms must be provided to contain the same so that this delicate machinery may not be contaminated with the dust from boiler or coal rooms, and so that all machinery units may be kept within close compass, thus being more easily attended to by the engineer. The electric switchboard should always have connection by telephone or speaking tube with the office of the principal or superintendent of the building. The engine room should be lighted from outdoors if possible, should be equipped with a clock containing the program or control and alarm bell, provided the same are used elsewhere in the building. The engine room should also contain a sink and water-closet for the engineer's use, either in the room itself or connected directly therewith.

FAN ROOM

Where blast fans are used for heating school rooms, ample provision must be made for them in the proper location. Most architects err in locating fan rooms by not providing for sufficient height or proper means of obtaining fresh outside air. It is always wise if possible to have fans located near the center of the building so that the work to be done will be symmetrically divided on both sides of the fan.

FURNACE ROOM

The general requirements of furnace rooms are similiar to those of boiler rooms except for the provision regarding cleaning of flues, but abundance of space should be left in front of furnaces for firing space. The height of rooms to contain hot air furnaces need not be made as great as that for rooms to contain boilers.

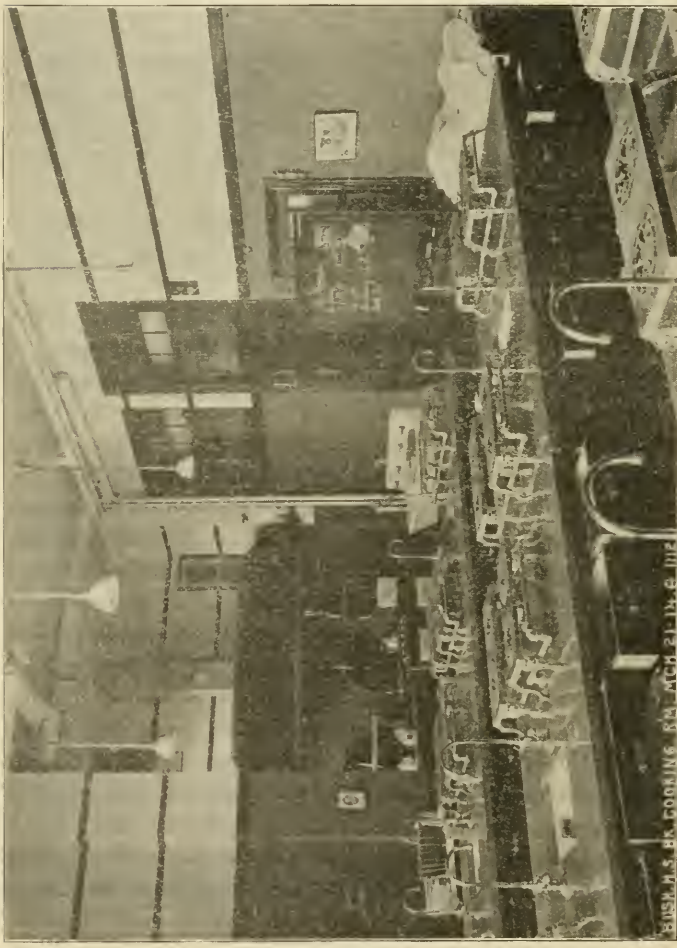
Where gymnasiums are used in school buildings it is safe to figure on an area for the gymnasium itself of about 8 or 10 square feet per pupil in the building, but every well equipped gymnasium should also have locker rooms, and rooms for shower baths and toilets for each sex in addition to the gymnasium itself. The height of a gymnasium should be not less than 20 feet and should be made 25 feet in the clear if possible. It is impossible to lay down any definite rule for the equipment of gymnasiums, locker rooms, etc., because the requirements and supply of money are seldom the same in any two cases. Elsewhere in this book may be found the equipment schedule of the Boston public schools, which is a safe guide.

It is generally considered best to locate gymnasiums in basement stories, as it is much easier to sound-proof the ceiling than it is to sound-proof floors, which would be necessary in case the gymnasium were located in the upper stories. Every gymnasium must be provided with the most liberal provision for ventilation and, if possible, also have outside light, although the latter is not an absolute essential. It is not necessary that gymnasiums should be heated to a high degree, but provision should be made so that this matter may be within control.

Wherever possible, running tracks are provided in gymnasiums, the chief requirement of which is that no radius of any turns in same should be less than 15 feet, and that the floor of running track should be slanted to allow for the inclination of the runners' bodies. It is well to cover the floor of running tracks with cork, and also to have the slant especially designed so that the curves will be exactly correct. It is also of vital importance to so design the supports of running tracks that it will be impossible for runners to collide with them in going around the track, no matter how close to the outside rail they may be running.

The ideal floor for gymnasium is hard maple, cut opposite to the grain of the wood, although some authorities recommend hard asphalt and concrete covered with "battle ship" linoleum.

The use of pressed brick for inside walls of gymnasiums is preferable to any other wall covering, although hard plaster is used in some places. The circular iron stairway from the running track to the floor of gymnasium, and also the brass sliding pole, are features which may well be included in the building equipment.



Cooking room, Bushwick Avenue High School, Brooklyn, N. Y.

JANITOR'S ROOM

Where the machinery is looked after by the janitor, the engine room will answer the double purpose and no extra janitor's room be required, but in buildings containing no engine room and in buildings in which separate engineers are provided, the janitor should be given a room for his own use, containing toilet facilities and space for storage.

KINDERGARTEN

Primary, and in some cases intermediate school buildings, should have two kindergarten rooms, separated by sliding or folding doors, these rooms so isolated that games and music will not disturb other classes. The floors and walls should be carefully sound-proofed. These rooms should never be located above the first floor and should be provided with a separate toilet room, equipped with low fixtures of special pattern for the use of children. A circle should be painted on the floor and the walls of the room may well be finished in the manner described for drawing rooms, so as to provide for pictures, models, etc.

KITCHEN

In all school buildings where lunches are served to pupils, it is advisable to provide for a kitchen, the size and equipment of which will be dependent on the number of pupils daily to be taken care of. In any such room, however, ample smoke flues must be provided, a liberal sink equipped with hot and cold water, and such other equipment as the circumstances of the case demand.

LIBRARY ROOM

Most American cities of the present day have large libraries, so that it is rarely necessary to provide a library in school buildings larger than necessary to contain such works of reference as are especially required in the curriculum of the school. In every case, however, a library should be well lighted, conveniently located, equipped with metallic book-cases and also with

good, comfortable chairs and tables. In some of the larger high schools libraries are made sufficiently large to accommodate an entire class at one time. In smaller buildings where no separate library is possible provision is usually made in the superintendent's or principal's office for sufficient book-cases to answer the purpose.

LOCKER ROOMS

In connection wtih the gymnasium in basement, locker rooms should be provided for each sex, which should be well ventilated but may be lighted either by skylight or artificial light if necessary. The lockers usually employed are of sheet steel construction, and usually two tiers in height provided with a lock and key for the use of each pupil. Locker rooms usually also contain compartments about 4 feet square built of slate or marble partitions, and having either doors or curtains at the front, these compartments being used as dressing rooms for the purpose of classes doing gymnasium work. Locker rooms must always have immediate access to the gymnasium and also to the rooms containing shower baths and toilets.

Locker rooms are also provided in the upper portions of some school buildings, as described under the heading of coat rooms. Wherever locker rooms are provided and steel lockers made use of, it is wise to insist upon patterns which are connected with the exhaust ventilating system, so that air may be sucked through the lockers, thence to the wall risers and thus out doors.

LUNCH ROOMS

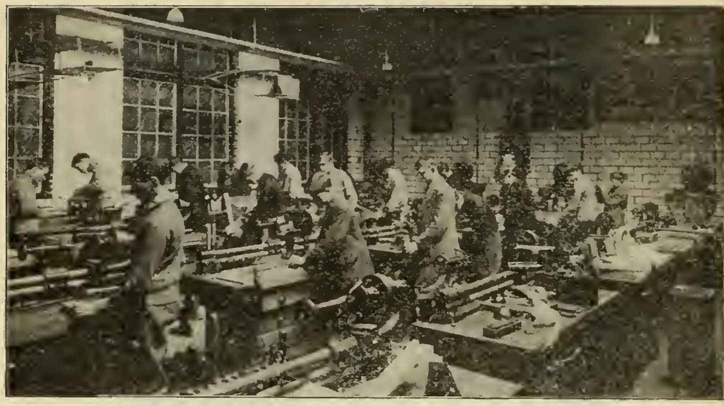
In nearly all large cities, high school buildings must be provided with lunch rooms for the convenience of pupils. In some buildings these rooms are not provided with conveniences for serving any sort of food, but are merely intended to provide a place in which pupils may eat lunches brought with them to school. This case is very simple, requiring simply a room of ample size and convenient location, equipped with broad-armed lunch chairs, such as are used in the various dairy lunches through-

Refectory, Scott High School, Toledo, Ohio.

out the country. In other places provision is made for serving warm food, and in such cases kitchens must be provided as above described and permanent lunch tables or counters at which the food may be served. It is impossible to give any general requirements, owing to the great difference in custom throughout the country in this regard, and differences in requirements and size.

MANUAL TRAINING DEPARTMENTS

Manual training departments of the present day school buildings usually consist of rooms in which are taught the art of joinery, wood-turning, forging and metal working. This de-



Lathe Room, Emerson School, Gary, Ind. Copyrighted 1911, Crose Photo Company.

partment should also always be provided with a liberal stock room for the storage of materials and tools. Manual training work is usually done in basement stories, and in portions of the building so located that the noise cannot easily interfere with the work in other portions of the building. Forges should, if possible, be connected with down draft suction pipes leading to exhaust fans, so that all smudge in these rooms may be forcibly drawn out and forced into the open air without contaminating the balance of the building. The equipment of each of the rooms or departments named depends entirely upon the scope of the work being undertaken, the number of pupils engaged in the work and the finances available for the building and equipment.

MUSEUM

Many school buildings contain museums, the chief requirements of which are that they should be well lighted, should be fire-proof and equipped with the necessary cases of proper design for displaying the exhibits belonging to the school.

MUSIC ROOM

As a general rule music is taught in separate classes, but many buildings also contain separate rooms for the teaching of

music. Such rooms need not be seated with desks but use may be made of the wide armed lecture chair ordinarily used in lecture rooms. Blackboard space must be provided and some musical instrument such as piano or organ.

OBSERVATORY

Where high schools are equipped with observatories it is essential that the walls supporting same must be solid masonary from the ground to the observatory floor, and it is also essential that the floor upon which the observers walk must not at any point be in contact with the floor which supports the instruments. The designing of observatories is an art in itself and the utmost care should be exercised in providing for one which will work satisfactorily. The majority of high school observatories in existence at the present time are not satisfactory.

PHYSICAL LABORATORY

As stated with regard to other laboratories, the size and equipment of the physics laboratory is dependent upon the number of pupils, the size of the building and the financial assets in hand. In the larger buildings the physical laboratory is arranged en suite with a physics lecture room, apparatus room, balance room, dark room and also, where possible, a private laboratory and office for the instructor of the department. The chief requirement of design in the physical laboratory is that none of the work tables should contain any metal whatever in their construction and that wherever it is necessary to use metal in any portion of the room, it should not be of iron or steel. The physical laboratory should be so arranged and designed that it will be as free from vibrations as possible, and most authorities prefer this department to be located directly upon the ground in the basement story.

PHYSIOLOGICAL ROOMS

Equipment should be practically the same as the biological rooms. In many schools they are identical. A small museum, and a small operating room for demonstrations upon small ani-

mas are convenient and useful, but not indispensable adjuncts to the suite.

PLAY ROOMS

In grade buildings throughout the country, play rooms should be provided but these are almost invariably located in the basement. They should be made as cheerful as possible, one being provided for each sex, and directly connected with toilet rooms. It is also advisable to have doors opening to the outside from basement play rooms and that stone or cement stairways be provided to give access directly therefrom to the playground outside. A splendid finish for the interior walls of play rooms is pressed brick.

Roof Play Ground, Washington Irving High School, New York.

PRINCIPAL'S OFFICE

Every school building supervised by a principal should contain an office for the use of the principal, and in large and important buildings both a public and private office and private

toilet room should be arranged for the use of the principal. In buildings where the board of education or its clerk do not have their offices, it is important that the principal should have a fireproof vault connected with his office.

RECITATION ROOM

Rooms for recitation purposes only, as distinguished from class rooms, differ therefrom in the matter of size and in the method of seating. Ordinary school rooms usually have fixed and permanent desks. Recitation rooms are usually equipped with wide armed lecture room chairs. School rooms seldom provide for more or less than forty pupils, but class rooms are arranged with provision for seating any number from twenty to one hundred. Such rooms seating more than forty pupils usually have the floors arranged in steps so that pupils in the rear seats may see over the heads of those in front. The rules for direction of lighting school rooms are not held to be as immutable, in the case of recitation rooms, as they are in ordinary school rooms.

REST ROOMS

Every school building should contain at least one emergency or rest room which may be used by pupils of either sex taken suddenly ill. These rooms should have a pleasant, sunny exposure, be well lighted and connected directly with a private toilet room. They should be equipped with a couch or davenport, easy chair a table and reading matter, and should have a small cupboard containing medicine and other conveniences suitable for rendering first aid to the injured or sick.

SCIENCE LECTURE ROOM

Every important high school building should be equipped with a large lecture room for the teaching of science, the floor being arranged in steps to provide for the seating of classes in chairs. The science lecture room should be provided with facilities for lantern exhibitions and should have a large and complete demonstration table with slate top on which scientific experiments of various sorts may be performed. The lighting in the room

should be so arranged as to be controlled by a switch, located on or near this demonstration table, and some provision should be made whereby the windows may be absolutely dark at the will of the instructor upon a moment's notice.

SHOWER ROOMS

In connection with gymnasiums, provision should be made for separate rooms for the use of each sex, equipped with shower baths. The type of baths to be used are fully described elsewhere. In, or adjacent to the shower room, should also be provided toilet rooms of ample capacity and correct design. The floor of shower rooms, locker rooms, toilet rooms, etc., should be of tile if possible, and certainly of waterproof material.

SHOPS

Rooms for the various mechanical trades of the manual training departments may well be located in one-story structures outside the main building, but in any case must be where their noise will not disturb school rooms. These rooms are usually unfinished, and have cement floors. Each room must be designed to suit the trade taught in it, and it is impractical to lay down any hard and fast rules as to size or equipment without knowing the work to be done, and the number to be taught. Abundance of light must always be provided.

STAGE

For description of stage requirements see Assembly Room, Dressing Room, etc.

STUDY ROOMS

In high school buildings where the plan of separating the classes into general study rooms is followed, these rooms are made of a size sufficient to seat one or more classes together at a time at desks, such as freshman-sophomore, junior-senior, etc. Where this plan is followed the general rules as to area per pupil, ventilation, lighting, etc., given in chapter on school rooms, should be followed. It is also important where the study room system is

Sewing Room, Washington Irving High School, New York.

used that ample locker or coat rooms be located in proximity thereto, for obvious reasons.

SUPERINTENDENT'S OFFICE

The requirements for superintendent's rooms are identical with those given for principal's office.

TEACHERS' ROOMS

Nowadays it is a poor school building which does not provide a private room exclusively for the use of teachers. In every building containing such features for pupils, there should, as a matter of course, be rest rooms, lunch rooms and toilet rooms for teachers of each sex employed in the building. These may be adjacent to, but should always be private from the pupils' rooms. In case separate rest and lunch rooms cannot be arranged for teachers, a flue for a hot plate and vent should be provided. If possible—especially for women teachers, the toilet rooms should adjoin the rest rooms. Closets or lockers for wraps, a book case, and easy chairs are desirable features of teachers' rooms.

TOILET ROOMS

The equipment of toilet rooms is fully discussed under the head of sanitation, etc., and it will suffice to say here that separate toilet rooms must be provided for each sex, and must be well lighted and ventilated. If possible, the ventilation must be performed by the suction of air through the fixtures, thence into the wall risers and out doors, this system being entirely separate from the general ventilating system of the building. Wherever possible, separate private toilet rooms should be arranged for the use of teachers of each sex, although these may be adjacent to the rooms used by pupils.

VAULT

Fire-proof vaults should be provided as stated in paragraph on principal's office and board room.

ZOOLOGICAL ROOMS

See Biological Rooms.

SANITATION

No effort will be made in these pages to deal with the subject of school hygiene which covers every aspect of school life likely to affect the health of children, such as periods of study, care of the eyes, discipline, medical inspection, etc. The purpose of the present work is to cover the essentials of correct school buildings without reference to administration.

Heating and ventilation also properly come under the head of sanitation, as nothing is more important for correct sanitary conditions than pure air, but this subject will be treated in a separate chapter. Sanitation as here considered will have reference only to those features of school buildings which conduce to healthfulness and comfort.

WALLS

In a previous chapter the recommendation has been offered that school walls should be finished smooth and decorated with paint, also that corners and mouldings should be finished round so as to admit of easy cleaning. The first step in the proper sanitation of the school building is to have it so designed as to be easily and perfectly cleaned. When these provisions have been made in the building itself, proper hygienic conditions of walls will be maintained if janitors are forced frequently and thoroughly to brush or wash down the walls, and if provision is made for having them recoated with paint at reasonable intervals.

In the designing of school rooms the use of wood frames around doors and windows should be reduced to a minimum, and the finish should be made as nearly like that which is used in hospitals as possible. It will be found that it is not necessary to use casings around windows and doors, as commonly done in dwelling houses, but that the jambs of doors and windows may be formed as shown in figure 2, page 28, thus eliminating all unnecessary woodwork, mouldings and other devices upon which dust is liable to gather and disease germs lodge.

SEWERAGE AND DRAINAGE

Reference has already been made to the necessity of waterproofing basements of school buildings to render them dry. It is even more important that school buildings be so situated that the grounds surrounding them may be readily drained, and that all sewage resulting from the building itself may be quickly and surely disposed of. Nearly all American cities at the present time have effective sewer inspection, and definite codes governing the construction of sewers, so that elaborate detail on this subject seems unnecessary. For cities in which no regulations exist it is very easy to obtain copies of codes from neighboring cities from which the standards of good work may be obtained. For buildings in country districts in which no sewage facilities are provided the service of sanitary engineers should be obtained to design sewage disposal plants to care for the sewage from the buildings. In every school building, the sewage and plumbing system should be made absolutely tight, rendering the escape of sewer gas in the building impossible. In buildings set with allowance for scant fall to the sewer, rendering the building liable to the danger of sewage backing up into the basement, proper valves or traps should be installed by means of which this may be rendered impossible.

PLUMBING FIXTURES

No part of the building so concerns its sanitary condition as the system of plumbing, and the plumbing fixtures which are installed therein. Probably no class of material entering into the construction of buildings has been brought to a higher standard in recent years than sanitary plumbing, and the best demonstration of this statement is an inspection of school buildings erected fifteen or twenty years ago in comparison with those being erected at the present time.

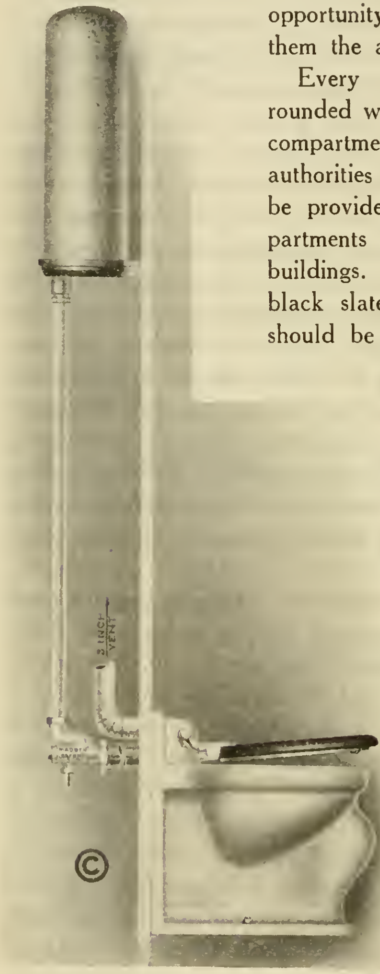
CLOSETS

Probably the first step in the present development, was the abolition of the range and dry closet systems, and the development of individual water flushing closets of sanitary design. The

process of development has been a long one, and has probably not yet reached its utmost perfection, but several types of water closets have been developed which are highly satisfactory for school use. First among these may be mentioned the system of closets known as latrines because they are the least satisfactory of the types now in use. They are merely a modern development of the old style range closet, in which a number of bowls are arranged consecutively and connected together in such a manner that the entire range may be flushed by the flow of water which is caused to pass through them at short intervals. They may also be provided with positive means of ventilation, but care should be exercised that the ventilation of closets has no connection whatever, with the system of ventilation controlling school rooms. The merits claimed for latrines are that they are so simple in construction that it is almot ismpossible for them to get out of order, and that the control of the flushing device rests entirely with the janitor who adjusts the apparatus as desired. Properly constructed latrines, connected with plumbing thoroughly well done, and so designed as to be flushed automatically and powerfully, are quite satisfactory and are being used in a large number of present day schools.

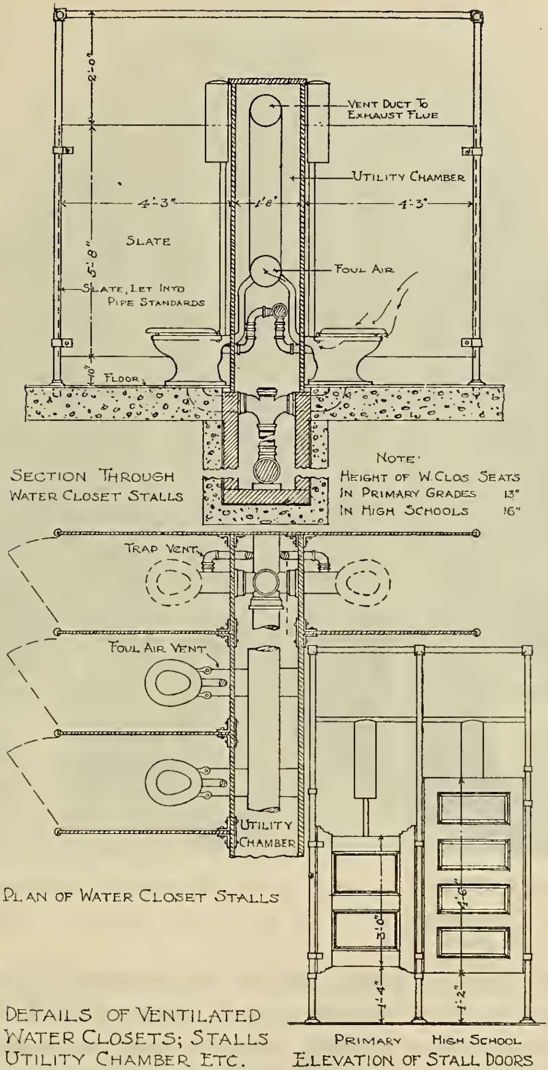
However, another and better type of closet is being used extensively, consisting of a porcelain bowl of either wash down or siphon jet pattern, so designed that pressure on the seat of the fixture admits water to the tank placed on the wall in the rear of the closet. When the seat is released the water in the tank immediately rushes into the bowl thoroughly flushing and cleansing it and no more water is wasted than the operation requires. It is impossible to make use of the fixture without having it thoroughly flushed with water at each operation, and the mechanical part of the apparatus is so hidden and protected from view that it is practically impossible for mischievous boys to cause any damage thereto. Various other forms of special closets for school buildings are on the market, but the one just described probably has more in its favor than any other type yet developed. One closet should be provided in each school building for every twenty-five boys and

for every fifteen girls. Near every closet or system of closets should be an ample number of lavatories supplied with soap and towels, not only to provide pupils the opportunity of washing but to teach them the advisability of so doing.



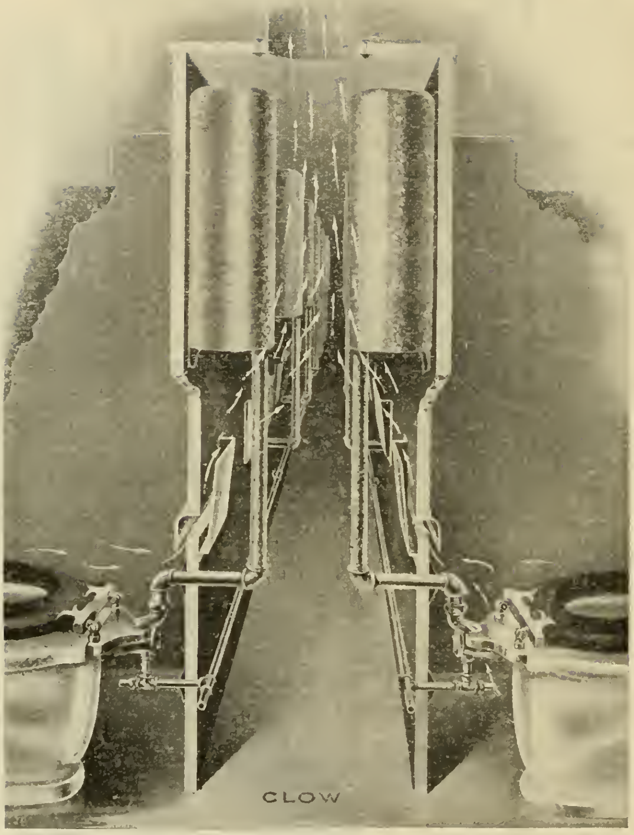
Every water closet should be surrounded with a partition, making a small compartment to ensure privacy, but many authorities contend that no doors should be provided at the front of such compartments in elementary and intermediate buildings. These partitions should be of black slate, soap stone or marble, and should be set up from the floor 10 or 12 inches and should be of such design that they may be frequently and easily cleaned. Water closets and closet systems should always be so arranged that they may be well lighted and easily cleaned. Wherever possible provision should be made for the positive ventilation of every fixture, but most certainly of every toilet room. The closet bowls should not exceed 14 inches in height, in the lower grades.

An excellent type of Water Closet which leaves no space under or behind the closet where dirt may collect, and renders cleaning very easy. Courtesy of James B. Clow & Sons, Chicago,



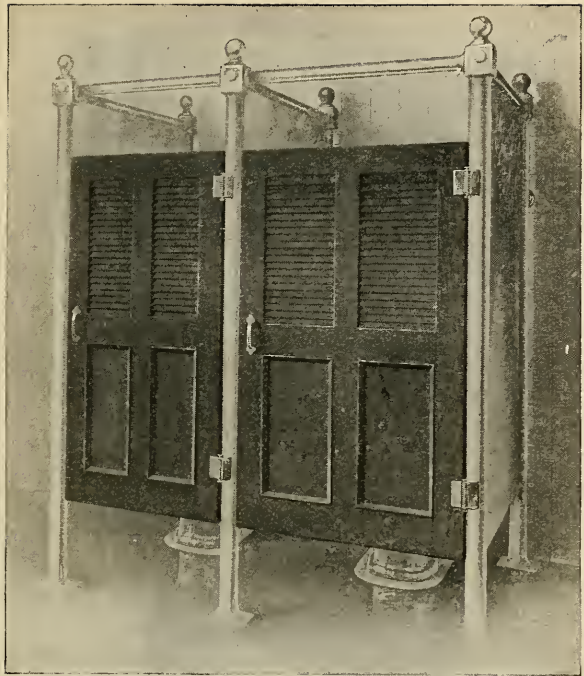
VENT DUCT TO EXHAUST FLUE
UTILITY CHAMBER
4'-3"
1'-8"
4'-3"
2'-0"
5'-8"
SLATE
SLATE, LET INTO PIPE STANDARDS
FOUL AIR
FLOOR
1'-0"
NOTE·
HEIGHT OF W.CLOS SEATS
IN PRIMARY GRADES 13"
IN HIGH SCHOOLS 16"
SECTION THROUGH WATER CLOSET STALLS
TRAP VENT
FOUL AIR VENT
UTILITY CHAMBER
PLAN OF WATER CLOSET STALLS
3'-0"
4'-6"
1'-4"
1'-2"
DETAILS OF VENTILATED WATER CLOSETS; STALLS UTILITY CHAMBER ETC.
PRIMARY
HIGH SCHOOL
ELEVATION OF STALL DOORS

FIG. 9.



PATENTED BY JAMES B. CLOW & SONS, CHICAGO.
Good arrangement of Closets and Utility Chamber to Ventilate as described on pages 79-80.

A utility space or working chamber should be provided behind the backs of closets wherever possible, wherein all tanks, flushing and plumbing pipes of every description may be concealed. A door must be provided for the admittance of inspection or repair men. In buildings having forced ventilation, these utility cham-



Standard design for Toilet Stall Partitions. Courtesy of The J. L. Mott Iron Works.

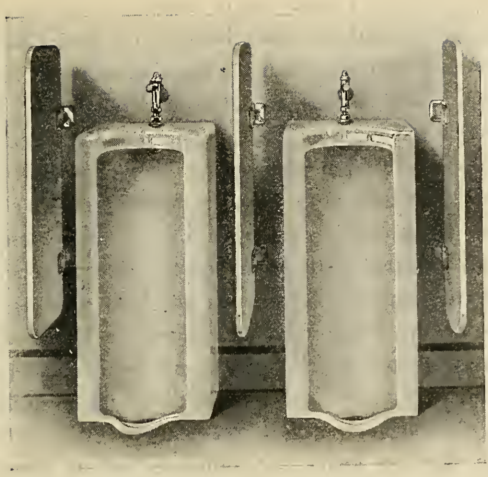
bers serve well the purpose of vent chambers, through which the closet compartments may be ventilated. Individual compartments should be at least 3 feet 6 inches, front to back, when doors are used, and they should be 30 inches or more in width. The doors should open out.

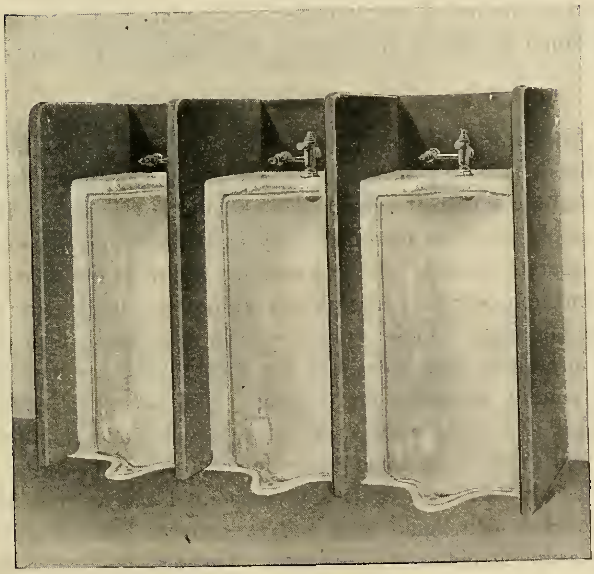
URINALS

Next in importance to the closets comes the urinal fixtures. A urinal which is sanitary must be so designed that it will (1) thoroughly flush frequently, (2) maintain a body of flowing water to keep the surface of the urinal constantly flushed without waste, and (3) be effectively ventilated. In buildings where

Good type of Ventilated Slate Urinal, such as described on page 83. Courtesy of James B. Clow & Sons, Chicago.

the saving of expense is an important item the best type of urinal now in use consists of a large exposed surface of black slate about 4 feet in height, the bottom of which is carried up from the floor about 4 inches and out from the wall about the same distance. The surface of the slate is kept constantly moist by a flow of water supplied from the top of the slab. Under the bottom of



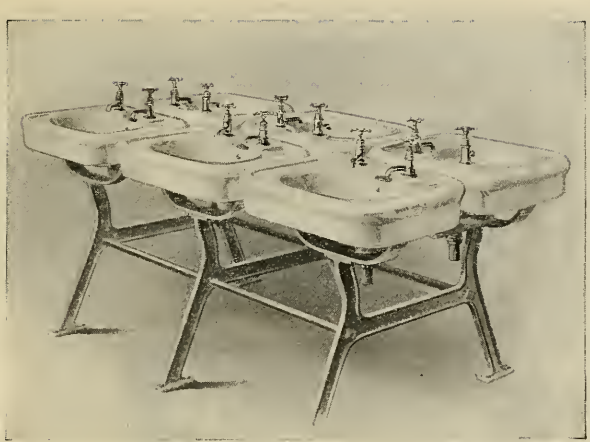


Porcelain Urinals in batteries. Courtesy of The J. L. Mott Iron Works.

the slab is provided a porcelain or cement trough into which the water is received, and the space back of the urinal slab serves as a vent chamber through which the air is drawn and forced to the outside air. Such urinals are illustrated herewith. Recently a much superior but more expensive urinal has been perfected, consisting of solid white porcelain about 18 inches wide and 4 feet high shaped like half of a cylinder standing on its end. These urinals are all made in one piece having all exposed surfaces glazed, and adjacent parts being fitted into each other with perfect cemented joints. The fixtures are built into the tile or cement floor of the toilet room and there are absolutely no open joints or crevices into which foulness may gather and produce annoying odors. Each urinal is provided with a flushing device which distributes water evenly over the concave surface of the urinal, the flushing being accomplished by an automatic tank which may be set to operate as often as desired. Each urinal is also supplied with a vent opening protected by a shield under the bottom of the urinal and thus perfect ventilation may be assured. One urinal should be allowed for every eighteen or twenty boys.

LAVATORIES

So many admirable patterns of lavoratories are on the market that it is hardly necessary to say much concerning them except that the matter of individual use should always be considered, and ample provision made whereby each pupil may have access to a separate lavatory when necessary. Many of the solid porcelain and iron porcelain enameled lavatories are suitable for use in school buildings. Those types are to be preferred which do not have any direct connection with the walls, and every part whereof is readily accessible for cleaning. All lavatories should be provided with self-closing cocks of substantial and durable pattern, and should have some device for controlling the waste, other than the old fashioned chain and stopper. Each lavatory should be provided with liquid soap and a container from which same may easily be obtained. Wherever possible, hot water should be supplied to the lavatory as well as cold water.



Standard School Lavatories. Courtesy of The J. L. Mott Iron Works.

SINKS

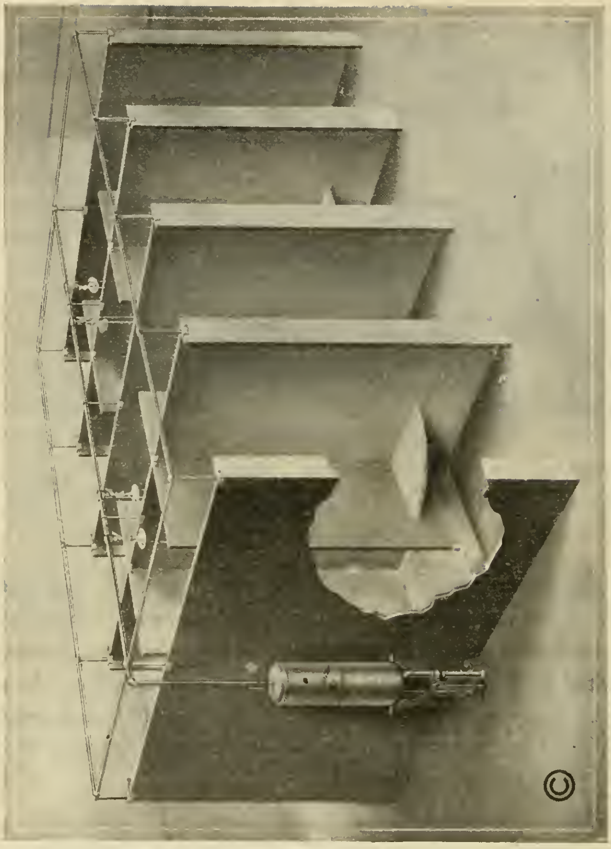
Sinks should be provided for the use of janitors, engineers, etc., which should be cast iron porcelain enameled, having roll rim backs in one piece with the sink. These sinks should always be supplied with both hot and cold water, where possible. In all cities where gas may be obtained, it is now possible to have an abundance of hot water, by means of instantaneous heaters, which are both effective and economical.

SLOP SINKS

On every floor, and in very large buildings in two or more places on each floor, there should be slop sinks, with hot and cold water if possible. These may be solid porcelain or of iron porcelain enameled. They should have a back 12 inches above the rim of the sink, the sink and back being all in one piece.

SHOWERS

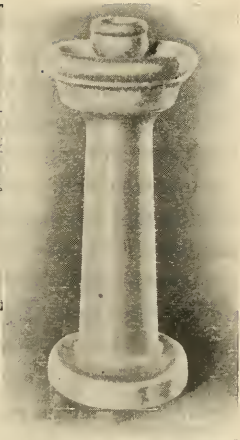
In buildings equipped with gymnasiums, or in which it is desirable to provide shower baths, they should be arranged in stalls consisting of a dressing compartment and a shower compartment



Standard Shower Bath Stalls and Dressing Rooms. Courtesy of James B. Clow & Sons, Chicago.

separated by duck curtains. The shower stalls and dressing stalls may be constructed of either black slate, soap stone or marble as the available funds may justify; and the shower stall should be not less than 3 feet by 3 feet, inside measure, the dressing stalls not less than 3 feet by 2 feet 6 inches, inside measure, and all stalls at least 6 feet 6 inches high above the finished floor. If the funds will admit the shower stall should have a marble or porcelain counter-sunk floor slab with combination drain and trap in the center thereof. A curbing of the same material as the stall

Battery of four Drinking Fountains in Iron Porcelain Enameled Basin. Courtesy of The J. L. Mott Iron Works.



All Porcelain Drinking Fountain. Courtesy of James B. Clow & Sons.

partitions 6 inches high should be provided between the shower and dressing compartment to keep the water from splashing the floor of the dressing room. The dressing room should be provided with a seat of the same materials as the walls thereof for use in dressing.

Stall partitions should be set in the finished floor 1 inch. The wide variety of shower fittings manufactured is fully illustrated in the catalogues of the various manufacturers from which selection may be made in accordance with the funds available. Essentials in every outfit are that the showers should be of plain type, with shower head having removable face by means of ball and socket joint so the angle may be changed at the will of the bather. The shower should be provided with non-scalding valve, and should come from the wall or ceiling instead of from the floor. In the better class of work temperature regulating chambers are always provided and if desirable needle baths, sprays, etc., may be added to the equipment.

Another sanitary feature deemed necessary in every modern school building is the drinking fountain, the first and most important requirement of which is that it must be of some type which does not permit of the use of the old-style germ laden cup. Owing to this requirement, leading manufacturers produce pedestal fountains with porcelain bowls and with some type of bubbling cup on top, by means of which a stream of running water, arising therefrom, may be used for drinking without the necessity of any contact between the lips and the fixture. The better patterns of fountains are provided with self-closing faucets to avoid wasting water, and the fitting through which the water emerges is made of porcelain to prevent corrosion or discoloration which would result in case metal is used.

LOCATION OF SANITARY CONVIENCES

There is much discussion of the proper location of toilet rooms or sanitaries in school buildings. Some authorities assert that toilet rooms for children should never be placed in the basement and argue in favor of detached pavilions. Undoubtedly, it is best in the large and more expensive types of buildings to pro-

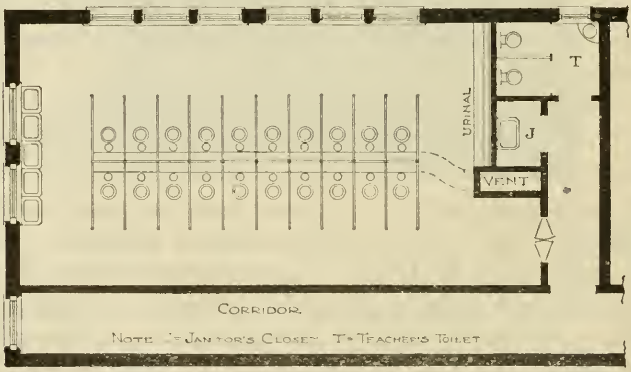


FIG. 10.

Figure 8 illustrates an ideal arrangement for toilet rooms for either sex, and shows the vent through which the foul air of the toilet room, after being drawn through the fixtures themselves is exhausted to the open air, outside the building.

vide ample toilet conveniences on each floor, located, wherever possible, in well ventilated wings or separate portions of the building,—ease of access and complete isolation being the two principal requirements regarding their location. In any case every school building should be provided with at least one toilet room on each floor for the use of teachers, and this may, without disadvantage, be arranged in connection with the toilet rooms for pupils. There can be no objection to the placing of toilet equipments in basements provided the basements are dry, well lighted, equipped with proper facilities for water supply and sewerage, and also provided there is a good positive system of ventilation of the compartments used for the toilet equipment.

FLOORS

The floors of toilet rooms must always be of non-absorbent materials. If constructed of cement the cement must be absolutely waterproof as elsewhere stated. Toilet room floors of unglazed or semi-glazed tiles, or of artificial plastic cement, make ideal materials for the purpose, especially because integral cove mouldings of same may be used at the walls instead of base mouldings, thus rendering it possible to keep the rooms absolutely clean. Wherever the supply of funds will admit, toilet rooms should be wainscoted with glazed tile or marble.

VACUUM CLEANING

One of the sanitary devices which has now been brought to a high degree of excellence is a device whereby buildings may be cleaned by means of vacuum equipment. Many different systems of vacuum cleaners are on the market, some of which are absolutely dependable and the cost of installing such plants is not relatively very high, especially compared with the positive and excellent results obtained therefrom. By means of such devices not only floors but walls, ceilings and any other portions of rooms desired may be thoroughly cleaned. Estimates of the cost of installing such apparatus, full directions concerning their use, and the results to be secured from them are readily obtainable from any of the manufacturers of such apparatus.

FIREPROOF AND PANIC PROOF SCHOOL BUILDINGS

Until very recent years the impression has prevailed that, owing to its excessive cost over ordinary construction, no method of fireproofing could be employed except in the largest and most expensive school buildings, because the voting public would consider such expenditure needless extravagance. This impression has been somewhat strengthened by the ever increasing cost of structural steel, and the difficulty of obtaining it without weeks or months of annoying delay, which also added to the expense and difficulty of fireproof construction.

Recently these conditions have become decidedly modified owing to three potent influences: (1) one or two frightful school calamities have awakened the public conscience to the conviction that it is almost criminal parsimony, instead of wise economy, to spare the added expense supposed to be necessary to render school buildings fireproof and panic proof. (2) The alarming scarcity of lumber has not only greatly increased the cost of timber for construction purposes, but the quality of timber now procurable in many parts of the country is so inferior, and of such short lengths, that various expedients of design have become necessary in order to render such timber usable at all. These expedients have seriously added to the cost of non-fireproof construction until there is but a narrow, and ever narrowing, margin between the ordinary type and the fireproof type of buildings. When to this factor is added the cost of fire escapes and other such devices, required in many of the states by law, it is found that there is little difference between the ultimate cost of the non-fireproof building and that of the so-called fireproof structure. (3) Most potent of all, however, must be mentioned the almost marvelous growth of reinforced concrete construction, by the use of which, intelligently handled, school buildings may be made

fireproof at practically the same cost as the ordinary combustible type of building; provided the latter is sufficiently complete to comply with the ordinary safeguards for life and health which are now demanded by the laws in the most progressive states. In addition to the moderate cost of reinforced concrete work, its increasing popularity is doubtless due to the fact that the ingredients entering into its construction may be found in almost every part of the country. Such steel as is necessary to reinforce the concrete may be made of the simplest patterns, everywhere procurable on short notice, and of such character that no steel company or corporation can easily work schemes for putting unreasonable prices upon them. Generally speaking, therefore, no progressive board of education should be willing to consider any school building proposition which precludes the possibility of fireproof construction.

One has only to think, for an instance, of the innocent children who were roasted to death in the frightful holocaust at Collinwood, Ohio, in 1907; of the homes thus darkened by the angel of death, and the desperate efforts of those in authority, in such cases, to find some excuse on which their blasted reputations can be hung, to become convinced that it is little short of criminal to participate in the erection of school buildings which are not practically fireproof and panicproof.

DEFINITIONS

The term fireproof, while well understood by competent architects, is still but a hazy term in the minds of many people. It is safe to say that there are few, if any, buildings which are absolutely fireproof, i. e., which could not be destroyed by any fire, however great, from without or within. But it is a safe statement that there are very many buildings in the country fireproof in the sense that they could not be utterly destroyed by any fire which can ever assail them, and in which the salvage in case of fire would amount to 70 or 80 per cent. Practically all of these buildings are indestructible by fire from within themselves, and could only be seriously damaged by fires of indiscribable

fierceness attacking them from the outside. In Chicago, the term fireproof construction applies to all buildings in which the parts thereof carrying weights or resistance, including all exterior and interior walls and partitions, all stairways, elevator enclosures, etc., are made entirely of incombustible materials; and in which all metallic structural members are protected from fire by incombustible materials. "The materials which shall be considered as fireproof covering or protection are, (1) burned brick, (2) burned wall tiles, (3) approved cement concrete, (4) burned terra cotta, and (5) approved cinder concrete." The definition of fireproof construction in the New York building code is in effect similar to the Chicago code; but is more explicit, especially with reference to the construction of high buildings. From the foregoing definitions it will be readily seen that school buildings are easily made of fireproof construction, and without the excessive expense which is contingent upon the construction of high office buildings, etc.

APPLICATION TO SCHOOL BUILDINGS

All walls of a school building, except mere dividing partitions, should be of solid brick masonry, particularly those walls which enclose or surround stairways. Dividing partitions, where necessary, may be constructed of hard burned terra cotta tile plastered with cement plaster. All floors should be constructed of either hollow terra cotta tile or entirely of reinforced concrete, preferably the latter. Stairways should be constructed of either iron or steel, or of reinforced concrete, and should be isolated in stairway halls and entirely surrounded with masonry or non-combustible materials. The stairway leading to basement should be kept strictly separate from stairways leading to upper portions of the building. Steep roofs, to be finished with tile or slate, should be constructed on steel trusses, the roof surface being formed of slabs of concrete or terra cotta tile and covered with ornamental tile or slate on the outside. Flat roofs may be of either tile or reinforced concrete and should be covered with asbestos roofing, waterproof cement or waterproof tiles laid in cement.

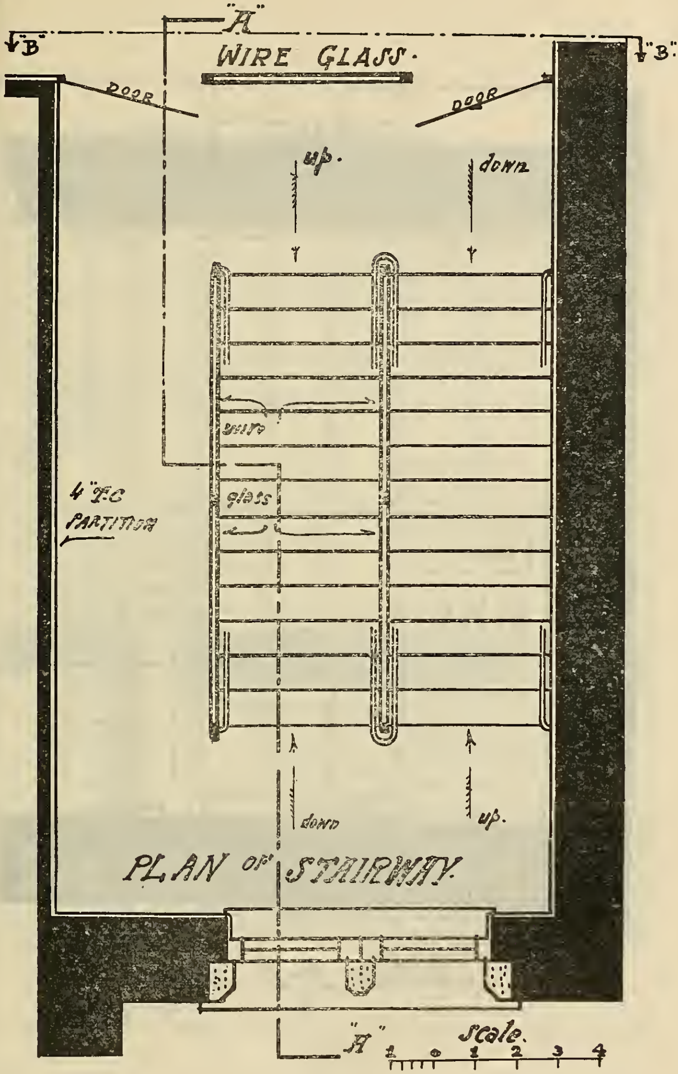


FIG. 11.

Stairway scheme. Construction entirely of steel and wire glass. Courtesy of The Mississippi Wire Glass Co.

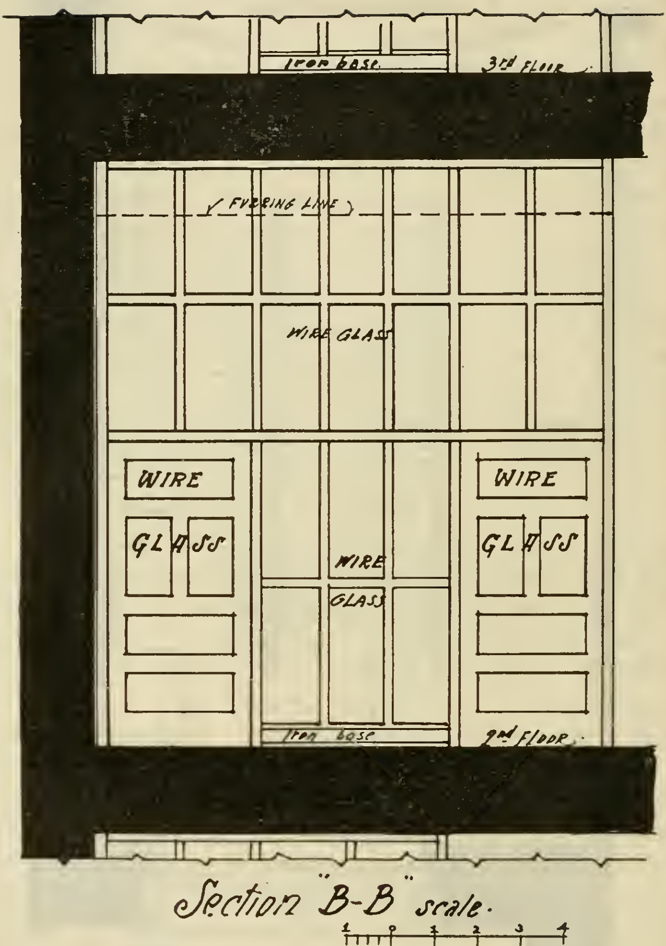


FIG. 12.

Elevation of Steel and Wire Glass Stairway. Courtesy of The Mississippi Wire Glass Co.

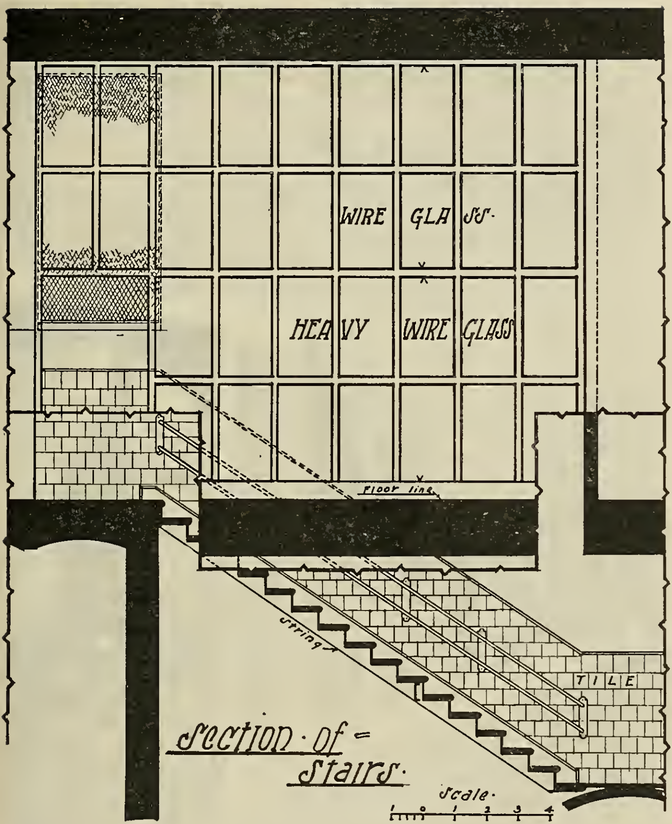
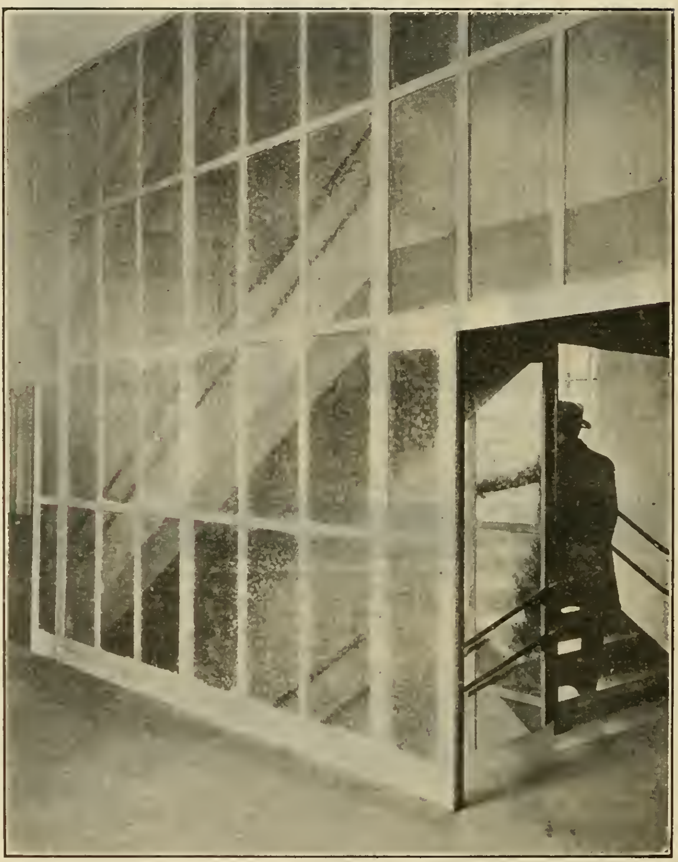


FIG. 13.

Steel and Wire Glass Stairway. Courtesy of The Mississippi Wire Glass Co.



Photographic view of Steel and Wire Glass Stairway. Courtesy of The Mississippi Wire Glass Co.

Various preparations are on the market, of a fireproofing nature, for finishing floors and this may be used in place of wood flooring; but buildings which are fireproofed as above outlined, may be considered well within every requirement of safety for school building purposes if the floors, doors and windows are made of wood. However, where sufficient funds are available, even the doors, windows and trimmings may be procured of non-combustible materials, if desired.

PRECAUTIONARY AND EXTINGUISHING APPLIANCES

Where school buildings are exposed to adjacent structures the utmost care should be observed in rendering the exposed portions of the school building absolutely fire resisting, with reference to the outside danger; which may be done by means of metallic frames and sash in windows and the use of wire glass. In case of an exposure of unusual risk and danger, a sprinkler system could be installed on the outside of the building so arranged as to provide a sheet of water pouring down over the building in case fire reaching a certain temperature should ever come against it. Sprinkler systems may also be installed in any portions of school buildings in which it is considered that an unusual danger of fire may arise, such as laboratories, manual training rooms, engine and boiler rooms; the above rooms containing combustible material.

Every school building whether of fireproof or ordinary construction should be provided with stand pipes connected with the city water system, or in case this source of supply is of questionable value, with a pressure tank located in the attic and kept constantly supplied with a large volume of water under pressure. Outlets from the standpipes should be provided on each floor and supplied with a liberal quantity of non-rotting hose equipped with nozzles, ready for instant use. In addition, fire extinguishers should be supplied in all school buildings, particularly in locations exposed to combustible materials as above named. The use of such devices are advisable even in buildings of fireproof construction, and their absence in combustible buildings is absolutely inexcusable.

It is a remarkable fact that even in buildings which are generally known as fireproof structures, it is still possible for accidents to occur which may give rise to frightful panics on the part of those occupying the buildings. This is, perhaps, especially noticeable in school buildings where little children are congregated in large numbers and easily frightened by any unusual noise, the smell of smoke, or an alarm of any sort indicating danger. The instinct for self-preservation often drives even adults to extremes which, after the passing of the excitement, seem to the actors themselves almost idiotic; but during the frenzy created by the alarm, reason is cast aside and the sedate human being actually becomes, for a time, an ungovernable maniac. For this reason much study should be devoted to the arrangement of school buildings so that the occurance of panics will be rendered practically impossible.

It is not necessary here to speak of the administrative duties of teachers in keeping pupils constantly drilled, in anticipation of fire or panic, regardless of the character of the building occupied by them. It is now universal practice, made necessary by law in many of the states, for teachers to require constant practice in this regard. Reference must be made however, to those features of arrangement and construction in the school building which, (1) render the creation of undue alarms practically impossible and (2) provide such facilities that even where the alarm does occur an escape to safety may be easily and quickly made. Some of these features have been touched upon in other portions of this work, but may be briefly reviewed here.

Every building should contain at least two fireproof stairways surrounded by fireproof masonary walls, not connected with each other in any particular, and if possible placed on opposite sides of the building. Under no circumstances, should a school building be designed with a central hall into which all stairways open. A fire or panic in such a hall would instantly and effectively block all means of egress from the buildings. There should be no connection in any case, between the stairways lead-

ing to the upper portions of the building, and the stairways leading down to the basement used as such—i. e., containing heating apparatus, etc. Every building should contain a liberal number of stairways and these should be of ample capacity. Buildings which are not of fireproof construction should contain emergency stairways, so that each emergency stairway will serve not more than two school rooms in the second story. Every school building should be constructed so as to render the use of outside fire escapes unnecessary. The latter are not only unsightly and expensive, but almost as dangerous as some of the features within a combustible building itself. School rooms in first story of combustible buildings should be provided with a doorway leading direct to the ground in addition to the usual exits by means of corridors, etc. Basement rooms should have an area space outside the foundation walls, and exits provided into the areas from every basement room to be used by pupils, so that instant egress may be had therefrom to the outside in case of fire or alarm.

DESIGN OF STAIRWAYS, ENTRANCES, ETC.

Every door in school buildings should open outward, whether leading from the school room to the corridor, the corridor to the vestibule or the vestibule outside. No top and bottom bolts should be permitted on any doors. No doors within combustible buildings should be provided with key locks, except main entrance door, library, book closets and boiler room doors.

The proportion of stairways is covered elsewhere in this work, but it may be added here that no stairway should have more than one landing and all landings should be of ample capacity. The outside wall of landings should be made octagonal or circular construction, reducing the landing space to approximately a half circule approaching in capacity that of the stairways. In case the stairways are of double width, as elsewhere described, the railings forming the division should be carried on a circle arc clear around the landing. The balustrade separating the upper from the lower flight of stairs should be made high, absolutely rigid and with no open space whatever

A Main Corridor in Franklin High School, Seattle, Wash. An excellent example of simple, direct corridor treatment.

between the top rail of same and the steps, this space being filled either with reinforced concrete, metal screen balustrade or some other similar device rendering it absolutely impossible for pupils either wilfully, or by pressure during a panic, to fall from one flight of stairs to the one below. A solid wall separating the two flights is the best design of all, but the same may be constructed of a steel frame fitted with wire glass, if desired, and this form of design is seen in many of the higher grade schools of the present day.

GENERAL PROVISIONS

In general, the danger of panics in buildings is made remote in proportion to the simplicity and directness of the plan. The more liberal, straight and thoroughly lighted the corridors are, the less danger there will be of panic. Secondary corridors should be avoided if possible, but in any case must be liberal in size, well lighted and not only have access to principal corridors, but if possible, to emergency stairways at the end of the secondary corridors. All emergency exits and other means of egress from the building which are not prominent and obvious at a glance should be prominently marked "EXIT." In case the buildings are used at night, lights should be provided in connection with these exits so that the letters will appear in red. Such exit doors not only should open outward, but be so fastened that it will always be possible to open them from the inside without difficulty. There should be absolutely no "dead ends," dark nooks, or useless spaces in which frightened children could become jammed without easy escape.

Every outside door should be equipped with panic bolts, which are a combination of bolts and locks so arranged that any pressure against the bolt from the inside of the building will instantly release the lock keeper and open the door. This is the only lock on the outside doors. In Ohio, these bolts are required by law on all public buildings.

Finally when every possible precaution has been made, the children should constantly be impressed with the fact that no danger can ever come from the building which they need to fear.

THE WIDER USE OF THE SCHOOL PLANT*

The most casual glance at the new school buildings of today reveals striking differences from the buildings our fathers attended or even the buildings of ten years ago. Thirty years ago school buildings rarely ever contained usable basements—even if they had been finished, and a finished basement was almost unknown. Many of those old basements were dark and damp and would not be permitted today even for storage cellars. They were rarely ever high enough to contain a modern system of heating or ventilating. Today the basements are high, well lighted, sanitary and well finished.

Prior to 1908 nobody ever thought that the school plant could be used at any time or way except for the brief daily recitation periods. About four o'clock in the afternoon the school children went scampering away from the building, instruction finished for the day. The janitor thereupon gave the building a thorough cleaning by the *old methods* and during the remainder of the twenty-four hours the building stood empty, forbidding and forbidden. Friday afternoon it was sacredly and securely locked up and trespassers warned away until the next Monday morning. On Saturday and Sunday the school grounds were forbidden territory, and also for three long months during the summer. During one hundred and eighty days the entire school property was used hardly seven hours a day including the janitor's time therein. One hundred and eighty-five days out of every year this valuable plant stood absolutely idle, unused and unusable. It was of service to no one and was simply deteriorating.

Within a very few years this has been largely changed. In many cities public school buildings are now open every week-day in the year—not only days, but evenings. The school plant today is being devoted to a wider use. It has become a place

* For the title of this chapter and much of the subject matter following the author is indebted to a book of the same title by Clarence Arthur Perry published by the Russell Sage Foundation of New York City. This work may be had of the publishers, and all readers desiring more extended and definite information on the subject are referred to Mr. Perry's excellent book and to other publications of the Russell Sage Foundation on kindred subjects.

where children may both play and study, where young men and women may continue their education up to the standard of the colleges of a generation or two ago; where even laboring men and shop girls may obtain free instruction outside of shop or store working hours, or enjoy profitable physical exercise after the weary grind in the shop or store; where neighbors may gather to visit with each other; mothers come together to learn how to be better mothers; where the laboring, business and professional men may come together and use the plant as a public forum and, in short, the activities now carried on in school houses and school yards during the margin outside the regular day school hours are so varied and numerous that it will be possible to mention only a few of the more remarkable in the present work.

An article in the Saturday Evening Post in June, 1912, by Frederick C. Howe, entitled "The Discovery of the School House," describes in a very interesting way the beginning of this wonderful change in public sentiment. The following quotation is from that article:

"Edward J. Ward discovered the school house. He discovered it up in Rochester four years ago. He invited some of his neighbors into the school one evening to talk things over. So much interest was aroused that they came again. At the first meeting there were three hundred and fourteen people present. They had music, recitations, dances. They found their neighbors were very pleasant people. Soon the building would not hold all who came. It was amazing how hungrily the people took to the idea. They had not thought of the school house as their property. They thought it belonged to the board of education. Soon other buildings were opened. Finally the schools were federated into a city-wide organization representing more than fifty thousand citizens.

"As soon as the people came together they saw the waste in the use of schools. They induced the board of education to appropriate five thousand dollars to keep them open fourteen hours a day instead of seven. They converted the kindergarten into a library and club room. They opened the gymnasium five

nights a week for athletic sports and one night a week for entertainments. Fathers and sons began to spend the evenings together on the rings, bars and tumbling mats. They had boxing and wrestling matches and basket ball games. The women formed a gymnasium class.

"Others borrowed a traveling library from the capital at Albany, subscribed for periodicals and bought a stereopticon and dining room appointments, so that they might give lectures and dinners.

"A short time after the school opened a merchant stopped the director on the street and said:

" 'The school center has done what I thought was impossible. I have been here nine years and during that time there has always been a gang of toughs round this corner. This winter the gang has disappeared.'

" 'They aren't a gang any more,' the director replied; 'they are a debating club.'

"The women organized clubs. They became interested in child labor, in city problems. The young people had debates, a banquet and a minstrel show. The school house became a family club.

"The men began to talk about Rochester. That was the club's undoing; but they could not avoid it. They called in the mayor, their aldermen, the health and school officials. They even had Governor Hughes down from Albany. They kicked about the gas company and the street railway service. They wanted transfers. Someone took a fall out of the local boss. Up to that time the boss had held Rochester in the hollow of his hand. He decided to run for congress, always a dangerous thing for a boss to do.

"But Rochester now had a forum for discussion. The people picked out a candidate of their own for congress, a man who would represent Rochester, and to the surprise of everybody they elected him."

Soon after the success of these experiments in Rochester a conference was held at Madison, Wisconsin, attended by many

prominent men, including Governor (now President) Woodrow Wilson, several other governors, senators, university presidents, editors, reformers, educators, architects and other soldiers of the common good who came long distances at their own expense to attend this conference because the University of Wisconsin had called Edward J. Ward to Wisconsin to promote there the Rochester school-center idea. In Wisconsin the people of any community can use the school houses in that state at any time by merely demanding it from the school authorities.

As a result of the work done at Rochester and of this conference, several hundred communities have now opened wide the school buildings for some purpose or other, and the larger cities are now spending hundreds of thousands of dollars annually for free school lectures, night classes and neighborhood gatherings, for social, recreational and civic purposes; until it is now certain that a complete reversal of public sentiment is at hand regarding this wider use of the school plant. Chicago alone has spent millions of dollars on recreation centers, playgrounds and people's club houses open all the year. Our large communities are fast becoming educated to the truth so well expressed by Mr. Perry, that "The girl without a social center is the mother of the woman on the street," and "If a city has to choose between the schools and the social centers it could, I believe, give up the schools more safely than it could go without the social centers." As a mere matter of good business this is a splendid change for the better, since the total school investment is now over one thousand millions of dollars in this country and the wider use of the school plant will go far toward saving an annual waste which has been something like thirty millions of dollars. But more important than the question of money saving must be reckoned the effect upon American life. The revival of the town meeting idea is a demonstration that we are getting more faith in all the people than we ever had before. The social center idea will be good for public morals and for a normal social life and it will be bad for graft because graft is opposed to social centers. It will make of the school house a life-long university where men and women who

have been deprived of educational advantages in youth may continue study at any time which they never had a chance to pursue before. Moreover it will be a truly democratic university in which all kinds of educational work will be carried on.

Naturally all of this change in educational systems and ideas immediately began to make changes in educational buildings. The architects also had dreams and just as truly as educators and reformers made the change in their fields, so have the architects been working out a new educational architecture the like of which the world has never seen and which no other country on earth can excel. Auditoriums for public and social gatherings and lectures; concert halls with movable seats so that the hall may be used for receptions, banquets and dances; stages for orchestral, choral and dramatic performances; gymnasiums swimming pools and other facilities for recreation; branch libraries and reading rooms; meeting rooms for mothers; basement rooms for bowling, billiards and other sports; restaurants where school children may get their noonday lunches and if desired neighborhood dinners be given; large well lighted corridors and special rooms provided with mural decorations, pictures and models of statuary, giving to the cheerless school house as much as possible of the sweet home atmosphere; laboratories where practical application of all scientific studies may be made and other laboratories where domestic science, domestic economy and the mechanic arts may be taught; but perhaps best of all, open air rooms are provided to be occupied by pupils of frail physique and particularly those of tubercular tendencies. All these and many other such features are being invented for the instruction and physical care of pupils of poor health and backward tendencies, for the benefit of people of all classes, and as a result for the benefit of our whole social fabric.

"The single roomed, shingle roofed little red school house of the olden time, with its cylindrical stove, split log benches, rattling and unmanageable windows has grown into a many storied building of brick, concrete, steel and stone with boilers,

engines and dynamos in the basement." An abundance of light comes into it without glare. Sweet, moist, pure air enters and leaves it without draft. Good health and good humor pervade its halls, and a new and better citizenship will be its ultimate fruition.

COST OF SCHOOL BUILDINGS

It must be self-evident that it would be impossible to arrive at any rule to govern estimates of the cost of school buildings. In the case of duplicates, it is of course easy to gauge the probable cost of number two by what number one has already cost, although even this procedure would be unreliable if a long time intervened between the construction of the two buildings. But no reliable rule of thumb exists by the use of which any one may tell accurately, in advance of actual bids or quantity estimates, just what a building will cost. Difference in time; difference in location; difference in ornamentation, construction and equipment—all these and other items affect the price, and seldom if ever are combined alike in any two buildings.

However it is interesting and valuable to have the cost records of school buildings reduced to some standard form of measurement, for purposes of study, comparison and guidance, within reasonable limits. Tell an experienced real estate man that such a lot is worth $100 a front foot in a certain city, and at once he has a mental picture of that lot possessing value to himself, by comparison with other properties. Tell an experienced school architect or engineer that such a school building in a certain city costs 20 cents per cubic foot, and immediately he can form a fairly accurate mental picture of what the building comprehends. Every experienced architect can price his own buildings by the cubic foot method with surprising accuracy, but the practice is not accurate for general application by different—especially inexperienced—persons.

The practice of most architects in estimating by cubic feet is to ascertain the entire area of the building including all projections, integral parts thereof (but not including projecting steps, areas, etc., at the ground level only) and then multiply this area by the height from basement floor to a line representing the mean

of the roofs. Having thus ascertained the number of cubic feet, the probable cost of the building is obtained by assuming some price per cubic foot, and multiplying the number of feet by the price. The result will be reliable or otherwise according to the reliability of the price per foot, and this can be reliable only when the proposed building is to be of identical character, location and of reasonably close date with some former one already built.

For the benefit of study and comparison the following tables are published from the Boston and St. Louis school reports, giving a variety of valuable cost data for several years past, concerning buildings in those cities. It will be seen that the price per cubic foot varies from 15 cents to 30 cents, and the average, for Boston is 21.3 cents, St. Louis 19.1 cents. The relative percentage of the various branches of work is given, and in some cases the cost per pupil.

If one were to seek some definite rule based on this data, the only one of real value would probably be the following: If attempting to build a school building according to Boston practice, and the Boston Code, allow at least 20 cents per cubic foot as the unit price. If attempting to build according to St. Louis standards, allow at least 18½ cents as the price per cubic foot.

The present Ohio Code, as enforced, is without doubt the most stringent and exacting school building code in existence at this time (1914). In many trials, it has been found that a building of the *plainest description*, almost absolutely without ornament, with flat roof and heated by furnaces, fan system, cannot now be built according to Ohio requirements whether fireproof or not, under 16 cents per cubic foot. If heated and ventilated by the "split" system (steam with heating and ventilating independent) and equipped with high grade plumbing fixtures, this price will be at least 18 cents per cubic foot. This for a very plain building, practically without ornament, and with very limited equipment.

Whenever possible costs per cubic foot are given with illustrations of school buildings in the following pages.

Table Showing Cost of Buildings, Cost Per Cubic Foot, Children Accommodated, Cost Per Pupil—Boston

Name of School Building.	Grade.	Building, Heating, Plumbing and Electrical Contracts.	Total Cost of Building.	Percentage Contractfs Bear to Total Cost o Building. Bldg.	Heat	Plum.	Elec.	Cubical Contents	Cost per Cu. Foot.	Proportion Contracts Bear to Cost per Cubic Foot. Bldg.	Heat.	Plumb	Elec.	Cubic Feet, Class-room.	Children Accommoda-ted.	Cost per Pupil.
				Per Ct	Per Ct	Per Ct	Per Ct		Cents	Cents	Cents	Cents	Cts			
Marshall	P	B 106,516.75 H 9,483.00 P 5,197.00 E 3,270.90	124,467.65	85	8	4	3	516,624	24	20	2	1	1	37,000	700	177.81
Wm E. Russel	G	B 158,189.52 H 15,132.40 P 9,580.29 E 5,622.35	188,524.56	84	8	5	3	894,941	21	17	2	1	1	50,000	900	209.47
Farragut	P	B 127 262.98 H 12,432.00 P 6,821.45 E 4,010.00	150,526.43	85	8	4	3	652,630	23	19	2	1	1	47,000	700	215.04
Paul Jones	P	B 95,095.75 H 10,376.00 P 5,324.00 E 3,574.60	114,370.35	83	9	5	3	510,386	22	18	2	1	1	36,000	700	163.39
Ellis Mendell	P	B 103,569.20 H 9,625.04 P 5,658.11 E 3,414 85	122,267.20	85	8	4	3	517,035	24	20	2	1	1	43,000	600	203.78
Jefferson	G	B 182,261.94 H 16,927.15 P 6,449.90 E 5,251.50	210,890.49	86	8	3	3	856,777	24	20	2	1	1	45,000	950	221.99

Table Showing Cost of Buildings, Cost Per Cubic Foot, Children Accommodated, Cost Per Pupil—Boston

Name of School Building.	Grade.	Building, Heating, Plumbing and Electrical Contracts.	Total Cost of Building.	Percentage Contracts Bear to Total Cost of Building.				Cubical Contents.	Cost per Cubic Foot.	Proportion Contracts Bear to Cost per Cubic Foot.				Cubic Feet, Class-room	Children Accommod'd	Cost per Pupil.
				Bldg.	Heat.	Plumb	Elec.			Bldg.	Heat	Plu'b.	Elec.			
				Per Ct	Per Ct	Per Ct	Per Ct		Cents	Cents	Cents	Cents	Cents			
Washington	G	B 263,661.16 H 28,305.94 P 21,417.05 E 12,157.45	325,541.60	82	7	7	4	1,300,792	25	20	2	....	1	43,000	1,500	217.03
Christopher Columbus.	P	B 136,966.08 H 16,244.00 P 15,519.00 E 4,783.00	173,512.08	79	9	9	3	727,068	23	18	2	2	1	30,000	1,200	144.59
John Boyle O'Reilly.	P	B 95,712.50 H 10,227.00 P 4,040.00 E 2,859.50	112,839.00	85	9	4	2	450,248	25	21	2	1	1	32,000	700	161.20
Oliver Hazard Perry	G	B 118,497.38 H 17,621.50 P 5,094.00 E 4,932.75	146,145.63	81	12	4	3	612,351	24	19	3	1	1	44,000	700	208.78
Mather	G	B 241,098.44 H 27,807.00 P 11,645.50 E 8,782.05	289,332.99	83	10	4	3	1,353,831	21	17	2	1	1	42,000	1,600	180.83
Thomas Gardner	G	B 113,769.15 H 15,994.04 P 6,038.00 E 4,466.38	140,267.57	81	12	4	3	735,573	19	15	2	1	1	52,000	700	200.38

Table Showing Cost of Buildings, Cost Per Cubic Foot, Children Accommodated, Cost Per Pupil—Boston

Name of School Building.	Grade.	Building, Heating, Plumbing and Electrical Contracts.	Total Cost of Building.	Percentage Contracts Bear to Total Cost of Building.				Cubical Contents	Cost per Cubic Foot	Proportion Contracts Bear to Cost per Cubic Foot.				Cubic Feet, Class-room.	Children Accommodt'd	Cost per Pupil.
				Bldg.	Heat	Plu'b	Elec.			Bldg.	Heat.	Plu'b	Elec.			
				Per Ct	Per Ct	Per Ct	Per Ct		Cents	Cents	Cents	Cents	Cents			
Oliver Wendell Holmes.	G	B 159,563.85														
		H 21,930.18														
		P 8,037.00														
		E 6,116.99	195,648.02	81	12	4	3	991,609	20	16	2	1	1	41,000	1,200	163.04
Samuel W. Mason.	P	B 99,527.64														
		H 10,447.00														
		P 4,990.00														
		E 3,360.00	118,324.64	84	9	4	3	438,223	27	23	2	1	1	31,000	700	169.03
Dearborn.	G	B 182,240.82														
		H 20,874.00														
		P 8,929.50														
		E 5,087.00	217,131.32	84	9	4	3	980,100	22	18	2	1	1	47,000	1,050	206.66
John Greenleaf Whittier.	P	B 61,053.55														
		H 7,540.70														
		P 3,551.00														
		E 2,590.90	74,736.15	82	10	5	3	325,051	23	19	2	1	1	32,000	500	149.47
James Otis.	P	B 90,867.00														
		H 8,767.00														
		P 4,889.00														
		E 3,295.00	107,818.00	84	8	4	4	411,645	26	22	2	1	1	34,000	600	179.70
Joseph Tuckerman.	P	B 61,875.79														
		H 8,422.00														
		P 4,226.70														
		E 2,898.76	77,423.25	80	11	5	4	330,171	23	18	3	1	1	33,000	500	154.85

Table Showing Cost of Buildings, Cost Per Cubic Foot, Children Accommodated, Cost Per Pupil—Boston

Name of School Building.	Grade.	Building, Heating, Plumbing and Electrical Contracts.	Total Cost of Building.	Percentage Contracts Bear to Total Cost of Building.				Cubical Contents	Cost per Cubic Foot.	Proportion Contracts Bear to Cost per Cubic Foot.				Cubic Feet, Class-room.	Children Accommodt'd	Cost per Pupil.
				Bldg.	Heat	Plu'b	Elec.			Bldg.	Heat.	Plu'b	Elec.			
				Per Ct	Per Ct	Per Ct	Per Ct		Cents	Cents	Cents	Cents	Cents			
William E. Endicott.	P	B 64,745.25 H 7,951.00 P 3,667.91 E 2,693.61	79,057.77	82	11	4	3	348,883	23	18	3	1	1	35,000	500	158.11
Sarah J. Baker..	P	B 130,016.23 H 18,673.00 P 7,625.00 E 4,880.00	161,194.23	81	11	5	3	702,384	23	13	3	1	1	29,009	1,200	134.32
Nathaniel Hawthorne.	P	B 54,682.82 H 7,518.00 P 3,100.00 E 2,611.25	67,912.07	80	11	5	4	281,305	24	19	3	1	1	31,000	450	150.92
Charlestown High.	H	B 253,157.94 H 18,711.25 P 13,970.00 E 10,216.00	296,055.79	86	6	5	3	1,267,608	23	19	2	1	1	....	540	548.25
Normal and Latin Group. Common Building..................	H															
Normal School..	H	B 276,559.15 H 26,338.97 P 13,169.48 E 13,169.48	329,237.08	84	8	4	4	1,392,843	23	19	2	1	1	....	.350	940.65

Table Showing Cost of Buildings, Cost Per Cubic Foot, Children Accommodated, Cost Per Pupil—Boston

Name of School Building.	Grade.	Building, Heating, Plumbing and Electrical Contracts.	Total Cost of Building.	Percentage Contracts Bear to Total Cost of Building.				Cubical Contents.	Cost per Cubic Foot.	Proportion Contracts Bear to Cost per Cubic Foot.				Cubic Feet, Class-room.	Children Accommod'd.	Cost per Pupil.
				Bldg.	Heat	Plu'b.	Elec.			Bldg.	Heat.	Plu'b	Elec.			
				Per Ct	Per Ct	Per Ct	Per Ct		Cents	Cents	Cents	Cents	Cents			
Girls' Latin	H	B 249,577.77 H 23,769.31 P 11,884.66 E 11,884.65	297,116.39	84	8	4	4	1,388,807	23	19	2	1	1	....	600	495.19
Patrick A. Collins.	G	B 148,397.59 H 14,133.10 P 7,066.55 E 7,066.55	176,663.79	84	8	4	4	725,561	23	19	2	1	1	43,000	850	207.84
Edward Everett.	G	B 82,868.43 H 15,542.00 P 4,665.00 E 4,440.00	107,515.43	77	15	4	4	516,678	21	16	3	1	1	32,000	560	191.99
Nathan Hale	P	B 54,599.35 H 6,682.00 P 3,397.47 E 2,553.00	67,231.82	81	10	5	4	333,379	20	16	2	1	1	28,000	480	140.08
John Cheverus	G	B 80,268.04 H 11,975.00 P 5,040.31 E 4,793.00	102,706.35	78	12	5	5	535,474	19	15	2	1	1	30,000	704	145.89

Table Showing Cost of Buildings, Cost Per Cubic Foot, Children Accommodated, Cost Per Pupil—Boston

Name of School Building.	Grade	Building, Heating, Plumbing and Electrical Contracts.	Total Cost of Building.	Percentage Contracts Bear to Total Cost of Building.				Cubical Contents.	Cost per Cubic Foot.	Proportion Contracts Bear to Cost per Cubic Foot.				Cubic Feet, Class-room.	Children Accommot'd	Cost per Pupil.
				Bldg.	Heat.	Plumb	Elec.			Bldg.	Heat.	Plumb	Elec.			
				Per Ct	Per Ct	Per Ct	Per Ct		Cents	Cents	Cents	Cents	Cents			
Peter Faneuil....	P	B $ 91,333.05 H 7,977.00 P 4,485.95 E 4,283.50	108,079.50	84	8	4	4	431,886	25	21	2	1	1	24,000	760	142.21
Dorchester High Addn.	H	B $110,996.60 H 12,933.00 P 6,170.37 E 4,762.68	134,832.65	82	9	5	4	580,869	22	18	2	1	1	....	700	192.62
Abraham Lincoln.	G	B $229,396.85 H 24,097.58 P 15,381.00 E 11,213.00	280,088.43	82	9	5	4	1,158,533	24	20	2	1	1	28,963	1,832	152.88
William Lloyd Garrison.	G	B $ 51,950.30 H 6,688 00 P 3,823.18 E 3,690.00	66,151.48	79	10	6	5	275,640	24	20	2	1	1	27,564	452	146.35

Table Showing Cost of Buildings, Cost Per Cubic Foot, Children Accommodated, Cost Per Pupil—Boston

Girls' High Addition.	H	B $ 97,396.76 H 9,716.50 P 3,274.39 E 4,075.00	114,462.59	84	9	3	4	522,018	22	18	2	1	1	....	400	286.16
Samuel Adams..	G	B $ 84,553.84 H 11,701.50 P 5,668.00 E 5,595.00	107,518.34	79	11	5	5	481,016	22	18	2	1	1	34,358	640	167.99
Lafayette*.........	P	B $ 51,234.56 H 5,321.34 P 3,544.84 E 2,703.50	62,804.24	82	8	6	4	220,000	28	23	2	2	1	27,500	352	178.42
John Lothrop Motley.	P	B $ 18,395.25 H 2,310.00 P 1,205.00 E 600.00	22,510.25	81	10	6	3	99,445	23	18	2	1	1	24,861	176	127.89
Charles Bulfinch.	P	B $ 64,545.73 H 6,980.00 P 3,900.00 E 3,500.00	78,925.73	82	9	5	4	365,368	22	18	2	1	1	30,447	540	146.16
George T. Angell.	P	B $ 45,153.50 H 5,000.00 P 2,900.00 E 2,101.00	55,154.50	81	9	6	4	208,762	26	21	2	2	1	26,095	352	156.69
John Winthrop	G	B $ 87,073.54 H 13,500.00 P 5,300.00 E 4,800.00	110,673.54	78	12	5	5	601,047	18	14	2	1	1	37,565	728	152.02
Mary Lyon.........	G	B $ 49,760.26 H 6,049.50 P 3,450.50 E 3,122.55	62,382.81	79	10	6	5	299,019	21	17	2	1	1	37,377	364	171.38

Table Showing Cost of Buildings, Cost Per Cubic Foot, Children Accommodated, Cost Per Pupil—Boston

U. S. Grant*	G	B $ 92,772.04 H 13,500.00 P 5,300.00 E 4,800.00	116,372.04	78	12	5	5	592,171	19	15	2	1	1	32,898	828	140.55
Lewis	G	B $ 85,416.29 H 12,600.00 P 4,600.00 E 5,474.90	108,090.29	80	11	4	5	642,178	17	13	2	1	1	37,775	778	138.93
Benedict Fenwick.	P	B $ 49,356.45 H 8,150.00 P 3,331.00 E 2,154.00	62,881.45	79	13	5	3	322,424	19	15	2	1	1	26,869	534	117.76
William Bradford.	P	B $ 32,638.04 H 5,987.00 P 2,700.00 E 1,504.00	42,714.04	76	14	6	4	251,002	17	13	2	1	1	31,375	364	117.34
Roxbury High Annex.*	H	B $ 62,677.39 H 7,820.97 P 7,784.80 E 4,724.79	78,007.95	80	10	4	6	413,359	19	15	2	1	1	....	200	390.04
Ellen H. Richards.*	P	B $ 34,118.06 H 6,600.00 P 2,400.00 E 1,400.00	44,518.06	77	15	5	3	229,258	19	14	3	1	1	28,637	364	122.30
Mozart*	P	B $ 17,680.00 H 2,870.00 P 1,816.00 E 420.00	22,786.00	78	13	8	1	108,542	21	16	3	1.7	.3	27,133	160	142.41

*Cost to February 1, 1913.

Note.—Since 1909 rated number of pupils and cost per pupil are figured by actual seating capacity of building according to size of class-rooms.

In this list of 47 buildings the highest cost equals 26 cents per cubic foot; the lowest 15 cents; the average 21.3 cents.

St. Louis (Mo.) Public Schools

Date of Contract / Name of School	Cost of Building			No. of Class Rooms	Cubical contents of. bldg. cu. ft.	Cost per Class room	Cost per cu. ft. cents	Nominal Capacity pupils	Cubic feet per pupil	Cost per pupil
1901—Emerson	General Work	$105,014.02								
	Plumbing	5,748.00								
	Heating	12,030.00	$122,792.02	20L	804,000	6,140.00	15.3	1000	804	122.79
1902—McKinley High	General Work	$298,901.39								
	Heating	42,373.35								
	Plumbing	30,198.26								
	Electric Work	13,780.53	$385,255.53	36A	2,142,000	10,702.00	18.0			
1905—McKinley H. Add'n	General Work	$47,079.11								
	Plumbing	697.00								
	Heating	5,670.00								
	Electric Work	4,508.76	57,954.87	11	232,500	5,269.00	24.9			
			443,210.40	47A	2,374,500	9,430.00	18.6	1557	1518	287.65
1902—Yeatman High	General Work	$310,885.32								
	Heating	42,307.10								
	Plumbing	30,487.68								
	Electric Work	13,742.33								
	Electric Fixtures	2,412.00								
			400,194.43	36A	2,359,000	11,049.00	16.9	1218	1935	328.56
1903—Blow	General Work	$128,751.50								
	Plumbing	7,032.65								
	Heating	12,965.50	148,749.65	24	960,800	6,197.00	15.6	1200	800	123.96
1903—Cote Brilliante	General Work	$139,368.10								
	Heating	13,569.50								
	Plumbing	8,118.00	161,055.60	24	958,256	6,711.00	16.3	1200	798	134.17

Date of Contract	Name of School	Item	Cost of Building		No. of Class Rooms	Cubical contents of. bldg. cu. ft.	Cost per Class room	Cost per cu. ft. cents	Nominal Capacity pupils	Cubic feet per pupil	Cost per pupil
1904	Teachers College	General Work	$119,873.00								
		Plumbing	9,608.69								
		Heating	13,500.00								
		Electric Work	5,652.99	148,634.68	13A	830,020	12,386.00	17.9	457	1816	325.24
1904	Clay	General Work	$131,143.37								
		Plumbing	7,213.45								
		Heating	11,832.80	$150,189.62	24	820,100	6,258.00	18.3	1200	683	125.15
1905	Farragut	General Work	$142,394.91								
		Plumbing	10,810.70								
		Heating	16,453.72								
		Electric Work	2,355.13								
		Electric Fixtures	1,247.00	173,261.46	24	942,000	7,210.00	18.3	1200	785	144.38
1905	Sigel	General Work	$128,476.26								
		Plumbing	10,070.00								
		Heating	16,510.12								
		Electric	2,355.12								
		Electric Fixtures	1,249.00	158,660.50	24	931,618	6,610.00	17.0	1200	759	132.20
1905	Henry	General Work	$162,843.72								
		Plumbing	9,557.68								
		Heating	20,788.30								
		Electric	2,690.00								
		Electric Fixtures	1,499.00	197,378.70	23	1,127,078	8,582.00	17.5	1150	980	171.63
1905	Lafayette	General Work	$141,303.91								
		Plumbing	9,678.45								
		Heating	16,032.54								
		Electric Work	5,556.25	172,571.15	24	866,984	7,190.00	19.9	1200	722	143.80

St. Louis (Mo.) Public Schools

Date of Contract	Name of School	Work	Cost of Building		No. of Class Rooms	Cubical contents of. bldg. cu. ft.	Cost per Class room	Cost per cu. ft. cents	Nominal Capacity pupils	Cubic feet per pupil	Cost per pupil
1905	Shepard	General Work	$135,780.25								
		Plumbing	8,922.00								
		Heating	15,456.50								
				$160,158.75	24	987,386	6,673.00	16.2	1200	822	133.46
1905	Clark	General Work	$163,244.01								
		Plumbing	8,965.15								
		Heating	17,375.58								
		Electric Work	5,406.25								
				194,990.99	24	984,578	8,125.00	19.8	1200	820	162.49
1906	Fanning	General Work	$150,670.13								
		Plumbing	8,567.50								
		Heating	17,682.56								
		Electric	5,306.25								
				182,226.44	24	1,005,367	7,593.00	18.2	1200	837	151.85
1906	Hempstead	General Work	$151,684.45								
		Plumbing	9,238.00								
		Heating	16,815.80								
		Electric Work	5,056.25								
				182,794.50	24	1,105,500	7,616.00	16.5	1200	921	152.32
1906	Webster	General Work	$142,921.56								
		Plumbing	8,926.10								
		Heating	18,889.00								
		Electric Work	5,673.00								
				176,409.66	24	807,039	7,350.00	21.9	1200	672	147.00
1909	Franklin			$214,528.16	26A	1,227,180	8,251.00	16.7	1050	1168	204.31
1909	Lyon			127,205.38	14	668,410	9,086.00	19.0	700	954	181.72
1909	Meramec		$122,946.20								
1911	Meramec	Completion of four class rooms	2,875.00								
				125,821.20	15	667,680	8,388.00	18.8	750	890	167.76

St. Louis (Mo.) Public Schools

Date of Contract — Name of School	Cost of Building			No. of Class Rooms	Cubical contents of. bldg. cu. ft.	Cost per Class room	Cost per cu. ft. cents	Nominal Capacity pupils	Cubic feet per pupil	Cost per pupil
1910—Madison			200,798.09	26	949,000	7,723.00	21.2	1300	730	154.46
1911—Harney Heights			198,620.85	20A	1,072,000	9,931.00	18.5	1000	1072	198.62
1911—Bryan Hill	General Work	$149,000.00								
	Plumbing	10,470.76								
	Heating	20,720.20								
	Heat Regulation	2,196.00								
	Electric Work	4,890.15								
	Vacuum Cleaning	1,270.00								
			188,547.11	22	1,092,000	8,570.00	17.3	1100	993	171.40
1911—Delany	General Work	$69,000.00								
	Plumbing	6,035.00								
	Heating	15,839.58								
	Heat Regulation	1,490.00								
	Electric Work	2,972.49								
	Vacuum Cleaning	900.00								
			96,237.07	10†	427,000	9,624.00	22.5	500	854	192.47
1912—Penrose			224,631.00	27	1,251,000	8,320.00	18.0	1350	927	166.40
1912—Grover Cleveland			$666,000.00	65A	3,762,000	10,246.00	17.7	1400	2687	475.71
1913—Special No. 1	General Work	$15,684.00								
	Granitoid Sidewalks	708.00								
	Concrete Fence	319.00								
	Iron Fence	695.00								
	Electric Work	795.00								
	Vacuum Cleaning	465.00								
			18,666.00	4	85,500	4,667.00	21.8	60	1425	311.10

In the Delany School a woodworking shop and domestic science suite are each counted as equivalent to two class rooms.

NOTES ON TABLE—R signifies recitation room; L signifies lecture room; A signifies auditorium. The Kindergarten room is counted as two class rooms. The cost of buildings includes all heating, ventilating, plumbing and electric work, all outside grading and improvements, all painting and decorating, and excludes only the cost of the slate for blackboards, pupils' desks, shop and laboratory equipments and portable furniture. In the case of the Bryan Hill, Penrose, Delany and Grover Cleveland High and Special No. 1 the cost given is the contract price; in all other cases the final cost is given. The number of class rooms as given above includes shops, laboratories, etc., which are used for class work, except manual training and domestic science rooms in basements of grammar schools.

In this list of thirty-seven buildings the highest cost is 29.9 cents per cubic foot; the lowest, 15.3 cents; the average 19.1 cents.

St. Louis (Mo.) Public Schools

Date of Contract Name of School	Cost of Building			No. of Class Rooms	Cubical contents of. bldg. cu. ft.	Cost per Class room	Cost per cu. ft. cents	Nominal Capacity pupils	Cubic feet per pupil	Cost per pupil
1907—Baden	General Work	$152,635.45								
	Plumbing	9,248.00								
	Heating	21,500.00								
	Electric	7,530.00								
			$190,913.45	21L	874,356	9,091.00	21.8	1050	832	181.82
1907—Gardenville	General Work	$71,694.17								
	Plumbing	5,833.70								
	Heating	9,587.00								
	Electric	2,161.50								
			89,276.37							
1908—Gardenville	Completion of five rooms		4,081.55							
			93,357.92	11	312,756	8,487.00	29.8	550	568	169.74
1907—Oak Hill	General Work	$139,686.91								
	Plumbing	12,954.20								
	Heating	22,381.00								
	Electric Work	6,360.99								
			181,383.10	20L	792,356	9,069.00	29.9	1000	792	181.38
1907—Shaw	General Work	$152,470.24								
	Plumbing	9,213.60								
	Heating	20,498.00								
	Electric	6,206.20								
			188,388.04	24	986,894	7,850.00	19.1	1200	822	156.99
1908—Soldan High			$630,243.99	77A	3,406,000	8,185.00	18.5	1627	2093	387.38
1908—Sumner High			311,664.99	39A	2,000,000	7,991.00	15.6	480	4167	649.30
1908—Carr			113,005.05	15	545,700	7,530.00	20.7	750	727	150.67
1908—Humboldt			181,131.00	21A	1,058,150	8,625.00	17.1	1050	1007	172.50
1908—Walnut Park			161,187.70	20L	834,600	8,059.00	19.3	1000	834	161.19
1909—Ashland			193,251.99	24	1,167,540	8,652.00	16.5	1200	972	161.04

HEATING OF SCHOOL BUILDINGS

Practically all works relating to school buildings treat the subjects of heating and ventilating conjointly as one subject. With reference to some systems this is fitting, because in them the heating and ventilating is performed at one operation, the heated air being used also for ventilating; but perhaps a more intelligent understanding of the subject may be obtained if the two processes are first considered separately and afterwards with reference to their relation to each other.

DIRECT HEATING

All systems of heating may be grouped under two general heads, (1) direct heating systems in which the heat radiating apparatus is located in the room being warmed, such as stoves, steam and hot water radiators, and (2) indirect heating in which the heat radiating apparatus is not located immediately in the room to be warmed, but in the basement or some other portion of the building distant from the room or rooms being warmed. There are buildings in which both the direct and indirect are used in combination, which systems are discussed fully in the chapter on ventilation.

One principle should be borne in mind constantly,—that ventilation on any positive or sanitary basis is an utter impossibility in rooms warmed by the direct system; heating is possible but no practical ventilation. It is also well to remember that the process of heating a room is a three-fold operation; (1) heating the air within the room, (2) heating the walls, floor and ceiling of the room, and (3) heating the air which may find its way into the room through crevices, around windows, doors, etc., to replace air which has leaked out in the same or any other manner.

HEATING DEVICES

Direct System.—The heating apparatus of the earliest schools undoubtedly consisted of enormous open grates or fire

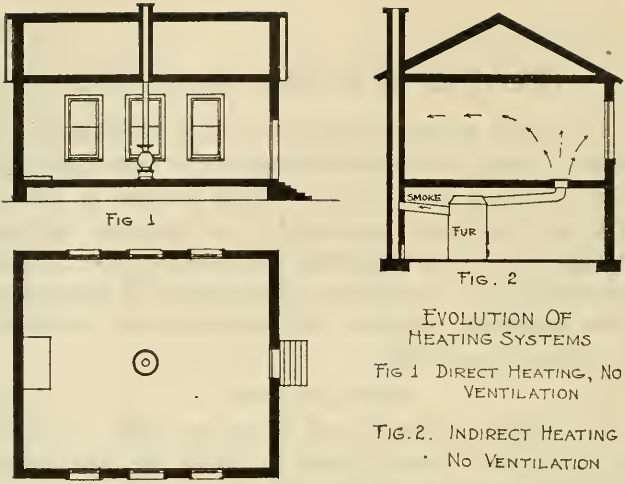


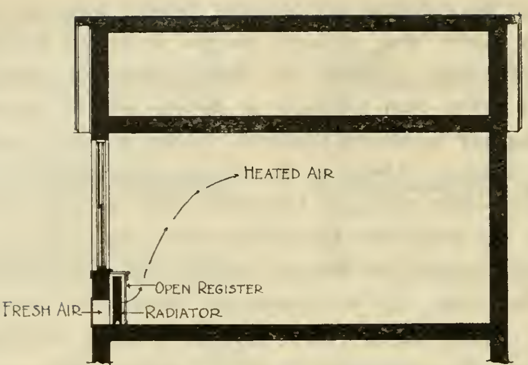
FIG. 14.

places which were, without question, bright and cheerful but not suited to school requirements. The open fireplace superheats those nearest the fire and leaves cold those at a distance. It is also expensive, as at least 50 per cent of the heat producing power of the fuel is lost through the open chimney. Open fireplaces may produce slight ventilation by reason of the draught created by the hot air passing up the chimney, but such ventilation is limited exactly to the amount of air which can leak into the room around doors, windows, etc., and such leakage rather contributes to the discomfort of the occupants of the room, than to ensure a perfect ventilating system.

Doubtless, the next step in the development of direct heating apparatus, was the modern iron stove which is still used, particularly in rural districts, for heating school rooms. Any sort of stove is but little better than the open fireplace, possessing all of its defects and no additional merit except that of economy. The stove produces even less ventilation and in fact possesses but one reliable characteristic,—the ability to produce a great deal of heat at one point in the room quickly, and with a limited quantity of fuel. With the use of steam for heating

buildings, the annoying and unsightly radiator came into use, and in many places soon replaced the old fashioned fireplace and stove; but steam radiators for direct heating of school rooms are little better than fireplaces or stoves, and are incapable of producing any ventilation whatever. They are chiefly admirable as dust catchers. Owing to the excessive temperature and rather depressing effect of steam heat, hot water is often substituted therefor, but aside from the different character of heat furnished by the two systems and the very slight economy resulting from the use of hot water, the two systems are identical in principle and results. Many schemes have been devised for modifying and elaborating the apparatus for direct heating, above described, and for combining socalled systems of ventilation therewith, but with very indifferent success. Even though flues are provided for the outflow of heated air from the rooms they do not ventilate, except in the imagination of the designer.

Indirect Heating.—Indirect heating is any system in which the heat radiating surfaces are located outside of the room to be heated. Indirect systems may consist of hot air furnaces, or a "Battery" of steam or hot water coils located at some central point or points in the building, the apparatus being so connected with the flues and piping that the air which is heated in the apparatus is conducted, in the flues, to the rooms to be heated. Flues or outlets are then provided in each of the rooms for the escape of the air in the room outdoors. Where no fan or blower is used, such a system is commonly designated as a gravity system, this phraseology being based on the theory that the heated air entering the room is rarified, by means of the heat, sufficiently to cause it to rise in the outlet flues and escape outdoors, thus creating space in the school room which will be immediately filled by other heated air and the operation thus kept up indefinitely; a theory, however, far from reliable or trustworthy. Where the operation is controlled by means of fans or blowers the result may be positive and sure, but this phase of the subject is treated under the head of ventilation.



EXAMPLE OF DIRECT-INDIRECT HEATING

FIG. 15.

In the systems of direct heating described it is assumed that the heating apparatus simply warms, and keeps warm, the air in the school room, no provision being made for the admission of fresh air or the egress of vitiated air except by leakage as stated. Indirect heating, however, involves some movement or change in the air of the rooms being heated, and a system of flues to provide for same; for if no means be provided whereby the air first in the rooms man find its way out, it is manifestly impossible to introduce fresh heated air from the basement, or other central point, into the rooms. Indirect heating therefore, has the advantage over direct heating that it necessarily involves more or less positive ventilation.

Direct Indirect Heating.—A system of heating once much in vogue, but now obsolete and little used, was the direct-indirect system, which can be used only in connection with steam or hot water. This system consists in the placing of radiators adjacent to windows or other openings, leading direct outdoors, the theory being that the heat in the radiators would induce currents of fresh air to pass from outdoors over the radiator into the rooms to be heated. Of course, no air whatever would enter the rooms in such manner unless flues were also provided whereby air in the

rooms might find its way through these vents outdoors, and even in such case, ventilation by this system is exceedingly uncertain. Systems of this sort give much annoyance through freezing of the steam pipes exposed to the cold air and it is impossible to construct a system so as to supply an ample and positive volume of fresh air for ventilation.

GENERAL PRINCIPLES OF VENTILATION

The physical health, and the effectiveness of all animal and human energy, are dependent to a wonderful degree upon the quality of air breathed. It is therefore impossible to overestimate the importance of maintaining, as nearly as possible, the normal purity of outside air throughout all school buildings.

"The blood is the life," and the life of the blood is *fresh air.* Fresh air is exhilarating, vitalizing, purifying. Without it, life would end in a few minutes.

The most essential element of life is not food, nor drink, nor light, nor heat, but *fresh air.* "Starvation is a matter of days with solids, hours with liquids, and of minutes with air." Fresh air is the very source of vitality. It turns the blue impure blood to rich red blood in the lungs and eliminates the waste tissues of the body and builds up the new.

As Prof. Woodbridge says: "air is as much matter as is water or ice. It may be clean or dirty; moist or dry; cold or hot; it may be measured and weighed; moved and brought to rest, and it may pass thro all these states and yet to sight appear the same." Where there is animal life, there is always atmospheric pollution and "atmospheric purity in the presence of that life is possible only when there is atmospheric abundance:"

The human heart pumps about twenty-six pints of impure venous blood into the lungs each minute for the purpose of purification. The lungs, however, can transform this blue venous blood into pure arterial blood only by extracting about six pints of oxygen from the air *per hour*, and throwing off a corresponding amount of carbonic acid, which is a deadly poison totally incapable of sustaining life. If the lungs could not throw off this carbonic acid, a man would die in a few minutes, the same as one who drowns, is hung or otherwise asphyxiated.

Just as the draft is as essential to the boiler fire as the coal, so air in purity and abundance is as essential to the vital fire as

is food. A good draft is of more importance to a bright fire than is good coal, for if the draft is good, a hot fire may be made and held with poor fuel, but with a poor draft the best of fuel will not make and sustain a hot fire. Inferior food with an abundance of exercise in the open air is better than the finest of food with the breathing of tainted and vitiated air. To boiler power and engine energy coal and air are equally essential. To vigor of body and to vital energy food and air are also equally essential. To both the quality of air is of more importance than is the quantity of fuel and food.

There is no menace to vitality and to the sum of the products of vital energy so continuously imminent, so insidious so effectively active as are the *invisible* wastes of the body. The dead of the weapons of the world's battle-fields are few compared with those whose lives have been either blighted or prematurely ended because of failure to maintain the body in a correct relation to the atmospheric source of abundant energy waiting to be transformed into vital force, and who have died for want of proper breath. He who would live at his best must breathe air at its purest. There is no material necessity to life greater than that of pure air. There is nothing so priceless and yet so costless as air. There is no financial investment which does or can yield so sure and so large returns as money wisely expended for pure air.

Ventilation, as contemplated by this work, refers to the continuous renewal of the air within buildings intended for school purposes. It will have no reference to accidental or imperfect ventilation, such as may be obtained through windows, doors or other such means, but only to such positive ventilation as may be brought about *only* by means of a definite supply of fresh air *forced* into the rooms at one or more places by means of *pressure* from the blower or otherwise, and the consequent displacement of the foul air in the room by means of the same pressure;—in short, will refer to a gradual, complete and continuous changing of the air from foul to fresh so that the air breathed by the occupants of the rooms will be at all times as near perfectly pure

as possible. No such result can be attained unless the volume of fresh air supplied is based upon the number of occupants, and length of periods during which the rooms are occupied; and unless the supply of fresh air, and the removal of foul air, is accomplished regardless of the varying internal and external temperatures, as well as the velocity and direction of the air outside of the building.

A few general principles, now well established, regarding the character and motion of air in a room should be kept in mind to insure an intelligent grasp of the subject.

(1.) The air in a room must be conceived of as a definite medium, just as one thinks of the water in a bucket which is filled to the brim with that liquid. As it is impossible to put more water into the bucket without forcing out of the bucket some of the water which is already therein, so is it impossible to force air into a room (uniform pressure being maintained) without displacing some of the air within the room. Further, the volume of air which can be delivered into any room is always equal to the quantity of air displaced therefrom, if the pressure remains the same.

(2.) The air of nature is a mechanical mixture of nitrogen and oxygen, with a little carbonic acid, a form of oxygen called ozone and more or less vapor of water. The amount of carbonic acid in the open air of nature is from 4 to 6 parts in 10,000 by volume.

In places where ventilation is not perfect, air contains also impurities such as sulphuretted hydrogen, sulphuric, nitric and other acids and often more or less solid matter like particles of dust. Air in rooms occupied by human beings becomes rapidly contaminated by the products of respiration from the human beings, the pores of the skin, etc. Air also contains bacteria or disease germs; and many authorities believe that the dust particles in air are largely responsible for the distribution or propagation of the bacteria of various diseases.

(3.) While the ends to be sought in ventilating are threefold (1) hygienic, (2) economic and (3) mechanical, both

heating and ventilating are most important for hygienic reasons. Pure air is as important to the human body as food and water. A candle will not burn in air improverished of oxygen. So, also, breathing impure air dulls the fires of the body and thus clouds the intellect. The more the bodily vitality is lowered, the greater is the danger of contracting both temporary and permanent disease. Real vital energy must not be expected in abnormal atmospheric conditions. If pure air is entirely absent, death is immediate. One cubic foot per minute will barely support life. Five or even ten cubic feet per minute admit of but low vitality; thirty cubic feet per minute will ensure vigor and health, but additional fresh air up to the point where noticeable draught begins, is the ideal condition.

(4.) The air in a room is always in motion owing to the fact that certain portions of the room, such as glass, may be colder or hotter than other portions, such as walls, and this inequality in temperature is certain to result in air motion by the force of gravity, cold air falling because of its density and heated air rising because of its rarity.

(5.) Carbonic acid gas expelled from the human lungs by respiration, or emitted through the pores of the skin, is 50 per cent heavier than pure air and therefore falls toward the floor.

(6.) The air in nature is purified by the action of winds, rain, lightning, etc., but it is impossible to purify the air inside of a building except by removing and replacing it by fresh air brought from out doors; therefore any socalled system of ventilation which does not positively produce this result is not in reality a system of ventilation at all.

(7.) Positive ventilation can be secured only where provision is made for (1) some source of power for forcibly moving the air, (2) flues and inlets for conducting the fresh air into the rooms, (3) outlets and flues for conveying the exhausted air again to the outdoors.

(8.) The quantity of fresh air necessary to maintain a fixed standard of purity may easily be determined, using the carbonic acid as the index. Each adult averages 20 cubic

inches of air at each breath, and about 20 respirations each minute. Knowing the amount of carbonic acid in pure air, and in air expelled from the human lungs, and knowing by experiment that discomfort if not harm attends the breathing of air containing more than 8 parts in 10,000 of carbonic acid, it is easy to figure the requirements for any standard. This subject is fully elaborated in Prof. R. C. Carpenter's excellent work on Heating and Ventilating Buildings.

In Massachusetts the state law requires that the ventilating apparatus of all school buildings shall supply at least 30 cubic feet of fresh air per minute or 1800 cubic feet per hour for each pupil, upon which basis the air in a standard school room containing 40 pupils would have to be wholly changed once in every 8 minutes. This has practically become the standard the country over.

INLETS, OUTLETS AND FLUES

The utmost care must be observed in designing inlets, outlets and flues for ventilation. It is an easy matter to bring a definite volume of air into a given space in a given time but it is often exceedingly difficult to accomplish this result, at the same time reaching all parts of the room with the fresh, pure air, but avoiding the formation of air currents, draughts and eddies. To secure satisfactory results the air should be uniformly distributed, should be warmed enough to prevent a feeling of chilliness on the part of individuals in the room, and should proceed at a speed which will not give the sensation of a draught. Air entering a school room should not have an initial velocity in excess of 10 feet per second at the opening of the flue, or in excess of 5 feet per second in the school room.

The best results are obtained when the air inlets are located at a considerable height above the floor and the outlets are located at the floor on the same side of room as the inlets. The advantages of this arrangement are that heated air tends to rise and spread uniformly just under the ceiling, after which it settles lower and lower in the room, gradually displacing the cool and foul air therein and the room is thus soon filled with fresh,

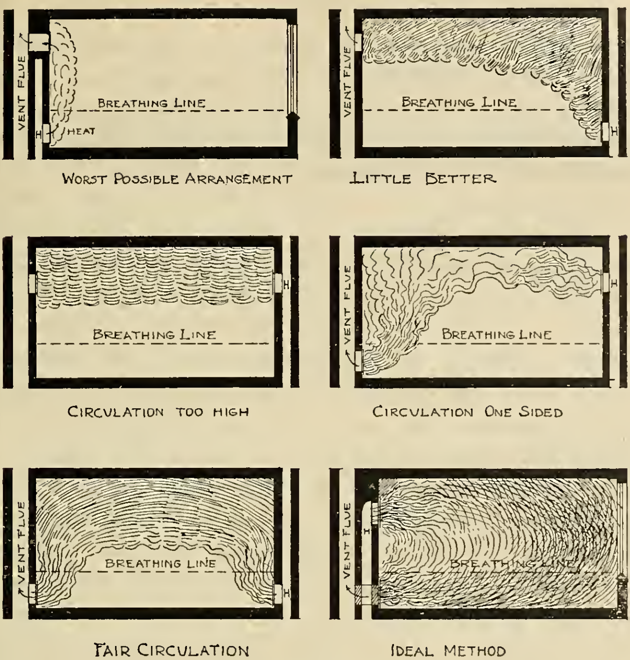


FIG. 16.

warm, pure air while the vitiated air passes out through the vent shafts under the impelling force of the fresh air which has been forced into the room. Mr. Warren R. Briggs, of Bridgeport, Conn., published in the third annual report of the Connecticul State Board of Health, 1879, the results of a series of experiments made by him to determine the most advantageous location of inlet and outlet flues for ventilation purposes. The results of these experiments were given in the work published by Mr. Briggs in 1899, on the American School Building. These experiments were conducted with a model having about one-sixth the capacity of an ordinary school room and the movements of the air were made visible by mingling smoke therewith whereby all changes undergone in the air were made visible.

These experiments are illustrated in figure (16). It is perhaps well to add that the practice of the best ventilating engineers and the experience of the years which have elapsed since these experiments by Mr. Briggs demonstrate the correctness and reliability of his conclusions, as to the direction of these air currents and the positive character of their action.

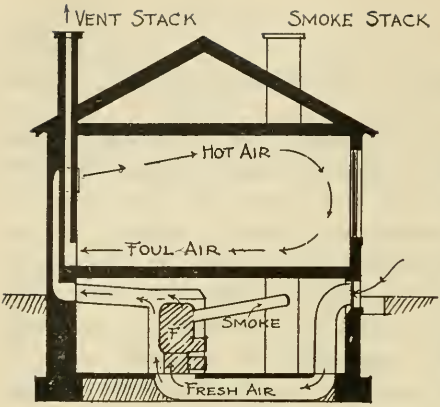
SYSTEMS OF VENTILATION

Until very recent years ventilation was regarded more as a luxury than a necessity. Although the discomforts of poorly ventilated rooms have always been known and deprecated, the apparent necessity of complex and expensive methods for correcting the difficulty has undoubtedly retarded the advancement in this department of building economy. But, as a result of the recent advance in hygienic science and experiment, it is now well known that the vitiated atmosphere of crowded rooms is positively and undeniably injurious, often leading to the propagation of various dangerous diseases, and that continued exposure to it is reasonably certain to be followed by serious consequences.

It is of the utmost importance that school buildings should be ventilated according to the most advanced knowledge and experience, and every school board should insist upon expert service in this department of building economy whether it has been afforded elsewhere or not. The practice, followed by many boards, of permitting various manufacturers to submit their own layouts is very unwise, and is continued no doubt because many architects, not skilled or experienced in designing ventilating apparatus, are glad to have manufacturers relieve them of expense in this manner. This procedure not only defeats all true competition, but has the additional defect of making the boards of education act in the capacity of judges of the various ventilating schemes submitted, which they are utterly incompetent to do, and many failures can be explained by this program. If any portion of a school building is worthy the attention of an expert surely this is it.

VENTILATION BY NATURAL METHODS

On the basis of least expense, natural agencies, such as air supply through doors and windows, were long depended upon, but it is apparent that such ventilation is not a "system" at all



GRAVITY SYSTEM
OF HOT AIR INDIRECT HEATING
AND VENTILATING COMBINED.

FIG. 17

This illustration shows diagramatically the principle of a gravity system of heating and ventilation, showing the path of outside cold air as it passes over the furnace, up into the school room and outdoors again through the vent stack. The motion of the air is produced by the heat of the furnace.

and is both spasmodic and disagreeable, if not dangerous because of draught.

VENTILATION BY GRAVITY

The first step away from ventilation by natural methods consisted in supplying buildings with flues either for the introduction of fresh air, the withdrawal of vitiated air, or both; but where no method was employed for *forcing* fresh air in through the former, or *drawing* the foul air out through the latter, such systems of flues were even less dependable than the natural processes above referred to. This led to a further step in advance known as the Gravity System and consisting of some means of encouraging or *inducing* a movement of the air from the rooms into the foul air flue. One such plan involves the use of two flues for each room, one leading into the room from a furnace, or battery of furnaces, located in the basement, and the other leading from the room to a point above the roof of the building. It is the theory of this system that when the air used for heating the rooms leaves the furnaces, it both rises and expands in volume, because of its heat and lighter specific gravity,

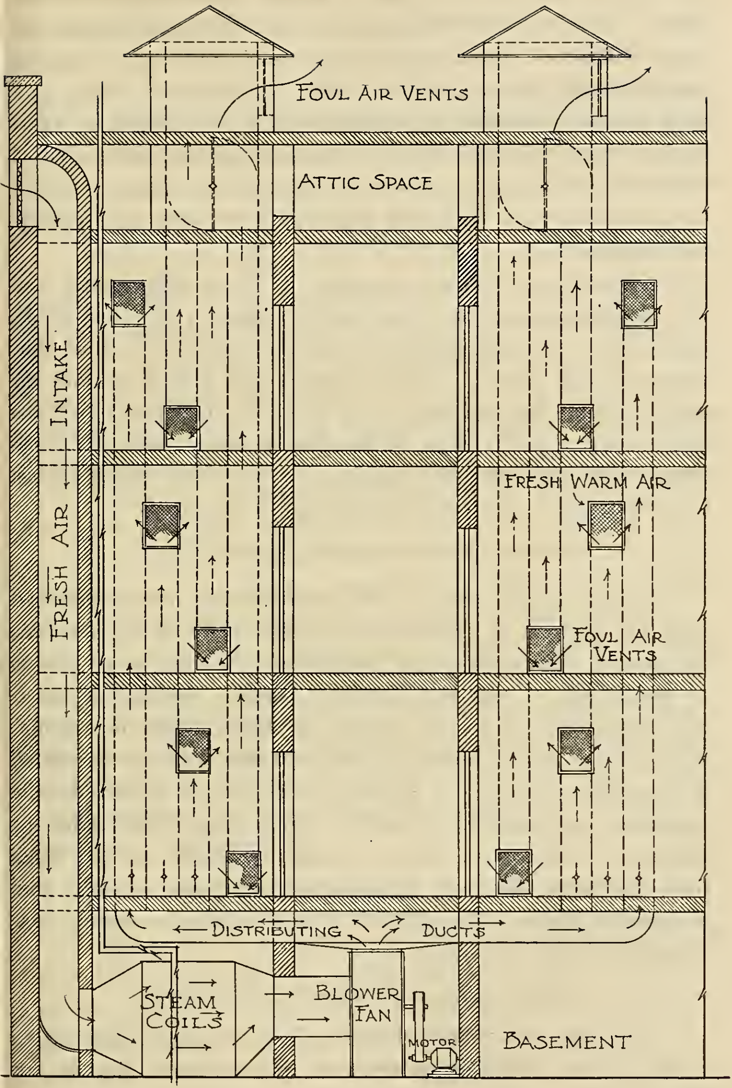


FIG. 18.

Showing proper arrangement of warm air and exhaust flues. Fan plenum system. No exhaust fan used.

and thus enters the room with a certain velocity due to these causes. This velocity is *supposed* to be sufficient to displace an equal volume of air already in the room and force it up the vent flue and thus out doors. This is a beautiful *theory* and such systems sometimes do operate with a fair degree of satisfaction when wind and weather conditions are favorable; but if the winds or weather are unfavorable, the system is just as certain to prove ineffectual and little better than no system of ventilation whatever.

A final step in the development of the gravity system consists in placing gas jets, stack heaters, steam coils, iron smoke stacks, etc., in the exhaust flues, with the idea that the heat thus generated will cause a positive draught and thus force foul air up the exhaust flue and thus out of doors, but the same objections may be urged to this phase of the gravity system, which is sometimes called ventilation by aspiration, as have been urged against the simple gravity system, differing only in degree.

FORCED OR MECHANICAL VENTILATION

The inevitable result of the unsatisfactory results obtained from all methods of ventilation previously referred to, has been the general conclusion of all authorities that there is no system of ventilation, of any sort, which is positive, uniform or otherwise dependable except the method of supplying air for ventilation *by force* from a blower or fan; and that if the air is wanted in a particular place, at a particular time, and in certain definite quantities and velocities, it must be *forced* to go there under the necessary conditions in spite of winds, weather and all other such conditions. Further, actual experience is demonstrating that no positive system of ventilation is so inexpensive—results considered—as the fan system.

VENTILATION AND HEATING COMBINED

Although the subject of heating has been separately treated in the present work, experience has demonstrated that in our climate it is never wise to operate the system of ventilation entirely by itself. The air used for ventilation should at least be

warmed to the temperature of the room into which it is introduced. In some systems the heating and ventilation is performed at one operation, the ventilating air being first forced through the heating furnaces or coils, thus raising it to a high temperature, in which condition it is introduced into the school room under pressure from the fan or blower. After passing through the room it is forced on out through the ventilating stacks, but not until it has performed the two operations at once.

The latter system while in more common use is not as good practice as the system in which the heating and ventilating are nearly independent of each other for the following reasons:

1. In order that the ventilating air shall not lose so much heat in its passage through the school rooms as to cause an unpleasant and cooling feeling upon the occupants of the room, it is necessary to overheat the air at the coil or furnace, thus cooking, or burning, and depriving the air of the humidity which it must have for ideal results.

2. Owing to the absence of this humidity the mucous membranes of the persons occupying the room become affected and are more liable to colds and other irritating affections.

3. Such dry air quickly affects the vitality and comfort, if not the health of the pupils occupying the rooms, and it is very frequently found necessary to resort to the opening of windows or transoms to secure fresh air in its natural condition of humidity because of the absence of same in the ventilating air furnished to the room, thus counteracting and nullifying the mechanical ventilation.

SYSTEMS OF FORCED VENTILATION

There are two systems of forced ventilation. (1) the Exhaust system, and (2) the Plenum or pressure system. The exhaust system consists in using a fan to forcibly withdraw the air from rooms. This system is now little used except for ventilating toilet rooms, chemical and other laboratories, etc., and as an auxiliary to the plenum system. In this system a partial vacuum is created within the apartment and,

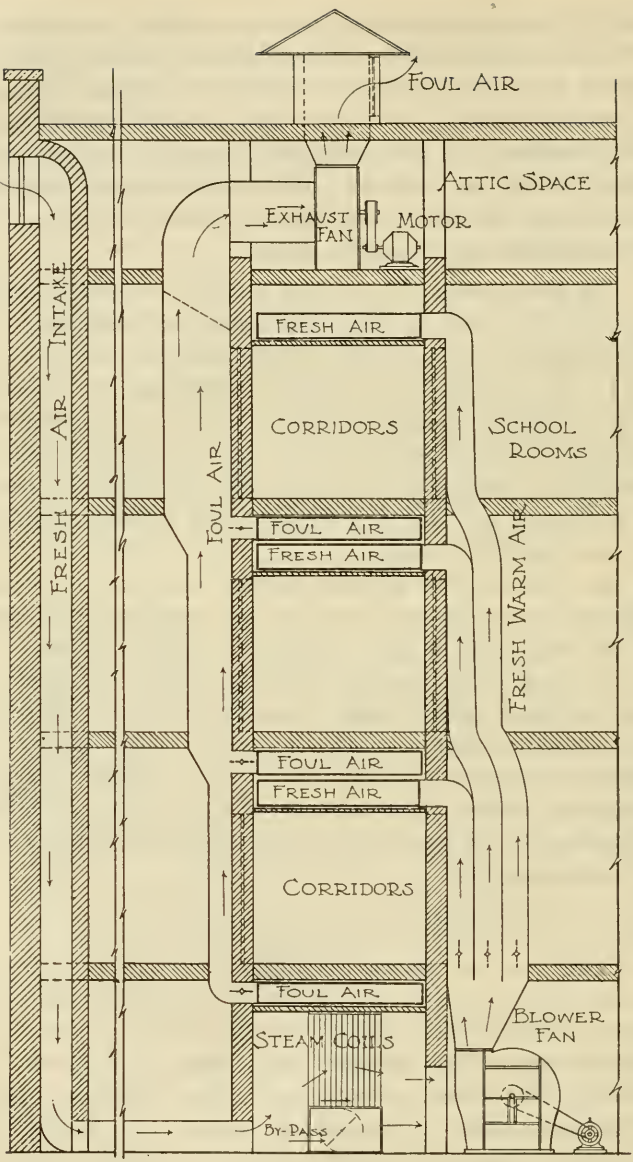


FIG. 19.
Showing Exhaust Fan System of forced ventilation; also illustrating the use of corridor ceiling spaces for main air ducts.

as all air currents and leaks are thus inward, there is nothing to govern the quality or velocity of the air, and it is difficult to provide proper means of warming it. In the case of toilet rooms, laboratories, etc., the system is very desirable, and in many buildings imperative. Further, the tendency of the air to leak from corridors and adjoining rooms into the toilet rooms, etc., because of the vacuum above described, is a positive merit rather than a defect in this case because it counteracts all tendency of foul smelling air to pass from these apartments into other portions of the building.

By the Plenum system, fresh, pure air may be forced into the rooms at any desired degree of temperature or velocity, at any desired degree of humidity, and under such conditions as may be positively controlled at all times; and all leakage is outward through windows, etc., thus preventing the drawing of polluted air into the room from any source whatever. Moreover, all air which is forced into the room by the Plenum or pressure system and owing to that pressure, forces out of the room an equal volume of the vitiated air, already in the room, and does so by positive measurable processes which remove all doubt as to the actual results accomplished. When it is remembered that the physical energy of the body is absolutely dependent upon a constant and positive supply of fresh, pure air, as surely as the energy of the engine is the result of the fires under the boilers, the vast importance of this result is easily realized.

HEATING AND VENTILATING AIR

Air used for ventilation is always heated in cold weather before its introduction into school rooms, and as already explained, may be sufficiently heated so that the heating and ventilating are performed at one operation. In buildings where steam or hot water is used for heating, the air for ventilation is frequently heated to only 70 degrees by means of indirect coils located in the basement, the idea being that the radiators in the rooms are to provide that heat necessary for the rooms, and the indirect coils in the basement are for the purpose only of temper-

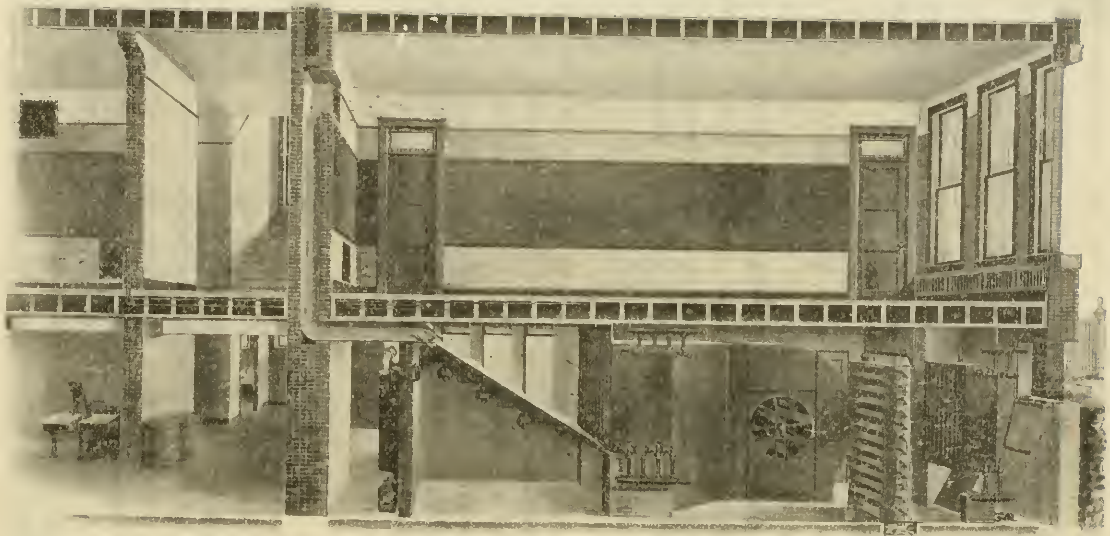


Illustration of a correct modern Ventilating Plant, shcwing air washer, steam coils, fans, etc., complete. Courtesy of The American Radiator Co.

ing the ventilating air so that it may enter the rooms at the same temperature as the air which is already in the rooms. This latter plan is considered far the best system of heating and ventilating now in common use and is much to be preferred over any system in which the heating and ventilating is done at one operation.

QUANTITY OF VENTILATING AIR

Professor Woodbridge says that "Only two considerations should be allowed to limit the quantity of air supply: Air draughts and bank drafts." In other words, ventilating air should be supplied in maximum quantities up to the point where danger arises from colds due to draught, provided the funds in hand will admit of such liberal supply. The length of time rooms are actually occupied continuously has much to do with the quantity of ventilating air which should properly be used in the rooms. Under the Massachusetts law, as first passed, it was attempted to require 50 cubic feet of air per capita per minute in public schools, but as it was found impracticable to obtain such a high standard, especially within reasonable financial limits, the standard was dropped to 30 cubic feet per minute which is now generally adopted in school work throughout the country as a *minimum* volume to be provided in any system of ventilation worthy of the name. As more and more attention is given to perfecting ventilating apparatus, the time will probably come when 40 cubic feet or even 50 cubic feet may be obtained within reasonable limits of expense and this is the goal toward which all progress should be aimed.

AIR VELOCITIES

In very good practice of the present day, the inlets and flues in ventilating systems for schools are so designed that the velocities of ventilating air will be as follows: Leaving the register into the room not over 300 linear feet per minute; passing through distributing flues and risers about 700 linear feet per minute; in mains and branches 1000 to 1500 linear feet per minute. The velocity of ventilating air in toilet rooms, laboratories, gymnasiums, physical training rooms and other special rooms may

be varied from the above to suit the special conditions as the judgment of the engineer dictates. But all such rooms should have much larger per capita supply than ordinary school rooms. See the Ohio code; heating and ventilating.

HEATING BY ROTATION

As a measure of economy, many heating and ventilating plants are so designed that for quick preliminary heating of the building the ventilating air is drawn from within the building itself into the fan chamber, and thence forced back again into the building, thus making a complete rotation of the building without contact with the cold air from out doors. This process no doubt saves expense in the initial heating of the buildings, and may be recommended for that purpose only, but all air for ventilating purposes, while rooms are occupied, should be drawn directly from out doors and if possible from a point above the building rather than near the ground.

AUTOMATIC CONTROL

Wherever the funds in hand will permit, the heating and ventilating apparatus should be automatically controlled, and no first class building may be considered complete without such control. Among many systems now on the market the Johnson system, the American system and the Powers system are probably in more general use than any others. One remarkable effect of impure air is to render the occupants of the room more or less insensible to heat. Thus both teachers and pupils in poorly ventilated rooms will frequently complain of cold when the thermometer indicates the actual temperature of the room to be as high as 75 or 80. Under such conditions, the addition of more heat, without pure fresh air, simply aggravates the conditions. Moreover, if teachers in various parts of the building are permitted to tinker with the heating and ventilating apparatus to satisfy their own whims, or even if an experienced janitor is allowed to have control of this matter, the results will prove very unsatisfactory and annoying. By the use of an automatic system the heat may be kept permanently at any desired degree in every

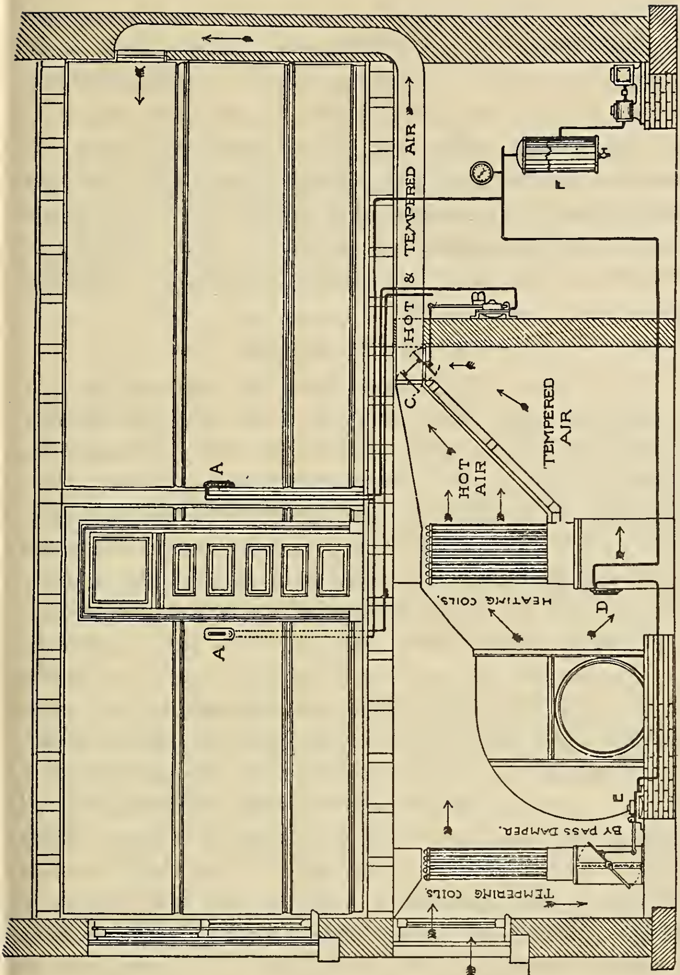


FIG. 20. Illustrating devices for automatically controlling heating and ventilating air. The controlling thermostats are at A. Courtesy American Regulator Co.

portion of the building, and the flow of ventilating air may be controlled according to the wishes of the superintendent of the building, and kept within any bounds desired. This result is accomplished by means of thermostats, located in each room, which are connected by means of compressed air pipes with

various dampers located at the proper points in the heating and ventilating system. In some of the systems the work is accomplished by means of electricity instead of compressed air. Thermostatic valves are also provided for attachment directly to steam or hot water radiators so that no matter what system of heating and ventilating is used, automatic regulation is not only feasible but has been demonstrated absolutely reliable. In general the cost of automatic regulation amounts to about one-tenth or one-twelfth of the cost of the entire heating and ventilating system.

LOCATION OF OPENINGS

The location of inlets and outlets for ventilating air is a very important matter and has much to do with the efficiency with which the ventilating air performs its work. Naturally the air currents within a room always tend downward owing to the cooling effect of windows and the outside walls, and the movement of the air which is thus slightly chilled is over the floor and back toward the warmer and inner walls again. The tendency of the air near the ceiling is naturallly toward the outer walls and the falling currents above mentioned. For these reasons the proper location for the air inlets is upon the inside wall at the point as nearly as possible central with reference to the outside or exposed walls, and the best practice includes the use of diffusers to spread the air in every direction horizontally, as it enters the rooms, in order to encourage its distribution into all portions of the room, and avoid the danger of a mere circling of air in a vertical plane from the point of inlet to the point of outlet. It is also advisable to have the inlet high enough to avoid any possibility of draught upon the occupants of the room and the best practice of the present day is to locate inlets at least seven feet above the floor level. From the foregoing reasoning, it will be obvious that the outlet for vitiated air should also be on the inner and warmer wall of the room, and should be in or near the floor so as to catch all impure air as it passes over the floor, before it has an opportunity to rise along the inside wall and become again a part of the air current ventilating the room.

Where it is possible to do so, it is advantageous to have two inlets and outlets for the purpose of better distribution of the ventilating air.

HUMIDITY

During the past few years, medical men, and scientists have been emphasizing the fact that moisture is a necessary and integral part of the human body, and that heating and ventilating systems are failures which do not in some way provide for this condition. The air we breathe must be not only pure, but to be ideally healthful must contain a certain amount of water vapor. The amount of moisture the air contains is called its humidity.

When air contains all the moisture it can carry without precipitating it in the form of water like rain, it is said to be "saturated." This condition is styled as 100 per cent humidity. Air containing no moisture is said to be at 0 degree humidity, the term humidity, as here used, therefore refers to the *relative* humidity in the air. The relative humidty in the Desert of Sahara is said to be 33 per cent, in the average American home and school room 20 to 28 per cent—or *dryer than the Desert of Sahara.* Physicians say these conditions are not conducive to health.

As the temperature increases, the capacity of the air to hold moisture also increases. The following table shows the actual weight of water that can exist as a gas or vapor in air at some of the ordinary temperatures:

Tem.	No. grains in cu. ft.	Tem.	No. grains cu. ft.
100	19.8	40	2.8
90	14.8	30	1.9
80	10.9	20	1.2
70	8.0	10	.8
60	5.7	0	.5
50	4.1	—10	.3

The amount of moisture in the atmosphere in a building is governed by (1) the temperature, (2) the nature of the evaporating surface and (3) by the rate at which the humidity is carried away. The correct percentage of humidity in school rooms is about 50 per cent.

If air is heated to 70 degrees or higher but without the addition of watery vapor, its capacity for absorbing moisture is very much increased, and it will take up moisture from all moist objects it touches. It will take it from the skin as rapidly as the skin gives it off. It will take moisture from the mucous membranes of the nose, mouth and the respiratory tract, causing more or less drying of the skin and these membranes, thus rendering them fit for the spread of disease. Dry skin, throat trouble, catarrh, colds, overactivity of the glands, etc., are thought to be caused in many cases by such loss of moisture from the body due to dry heat.

The pneumonia and croup period is the season of artificial heat in living rooms.

This dryness of the air also requires a higher temperature to give the same bodily sensation of warmth and comfort obtained at a much lower degree in air containing normal percentage of moisture. If a room at 70 degrees F. is not warm enough for any normal healthy person, the percentage of moisture is too low. Not more coal, but more water is needed.

FILTERING AIR FOR VENTILATION

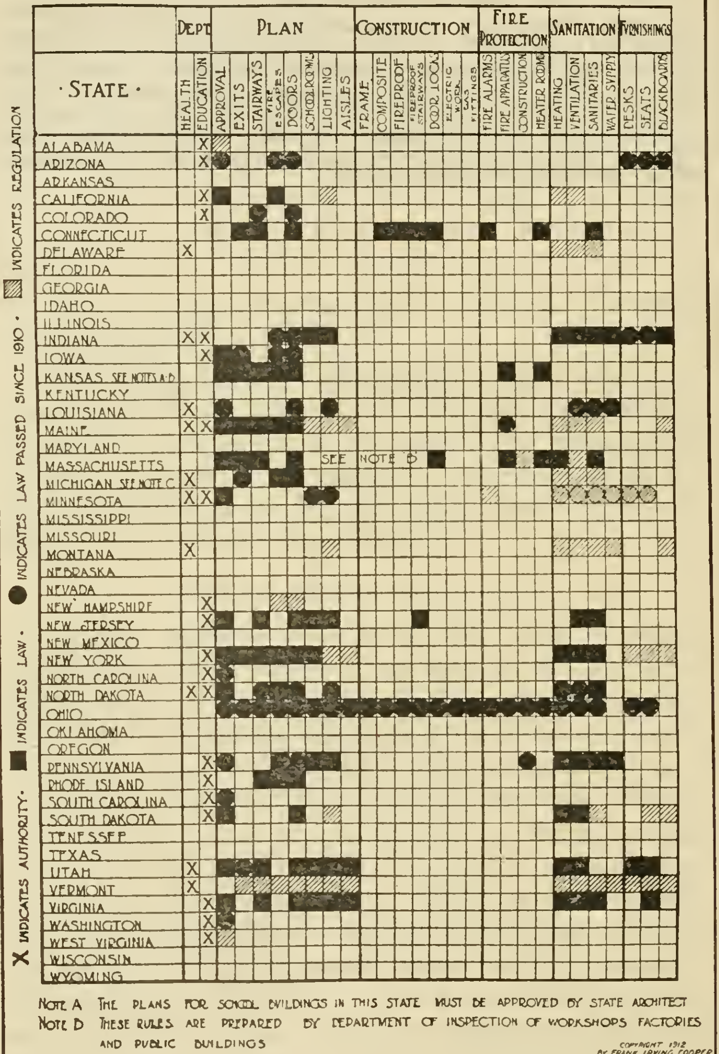
Another refinement found in the better grade of heating and ventilating plants, consists of air filters for the purpose of purifying the air of solid impurities which is used for ventilation. While such an equipment may be desired or necessary in some localities, it is not as yet considered of sufficient importance to be included in the majority of American school buildings. Hygienically considered, it is not of great importance, as the filters would in no case remove disease germs. And simply to remove dust from the air by the ordinary methods of filtration requires so much extra fan power in forcing air through the filters that the result does not justify the added expense, except in closely congested, smoky and murky city districts. It has been estimated by some one that 6000 tons of soot hang over London every day. All cities are overhung with much smoke, soot and dust and every

possible expedient should be employed to prevent this from passing into the school rooms.

NOTE:—All readers who care to study a more exhaustive and technical paper relating to the warming and ventilating of school buildings are referred to a treatise written by Professor S. H. Woodbridge of the Massachusetts Institute of Technology for the Board of Education of the State of Connecticut in 1898. Professor Rolla C. Carpenter, in his exhaustive work on Heating and Ventilating Buildings, page 430, publishes this treatise and pronounces it the best general discussion of the subject hitherto published. The author acknowledges this paper to be his authority for many of the conclusions on this subject contained in the present work.

CHART SHOWING STATUS OF REGULATION OF SCHOOLHOUSE CONSTRUCTION IN THE UNITED STATES IN 1912.

COMPILED BY FRANK IRVING COOPER. BOSTON



NOTE A THE PLANS FOR SCHOOL BUILDINGS IN THIS STATE MUST BE APPROVED BY STATE ARCHITECT

NOTE B THESE RULES ARE PREPARED BY DEPARTMENT OF INSPECTION OF WORKSHOPS FACTORIES AND PUBLIC BUILDINGS

NOTE C THESE LAWS AND REGULATIONS APPLY TO STATE BUILDINGS ONLY

STATE SCHOOL CODES

The following states are still without any definite laws or code governing the character of public school buildings, in regard to construction:

Alabama	Mississippi
Arizona	Missouri
Arkansas	Montana
California	Nebraska
Colorado	New Mexico
Delaware	Nevada
District of Columbia	North Carolina
Florida	Oklahoma
Georgia	Oregon
Idaho	Rhode Island
Illinois	South Carolina
Iowa	Tennessee
Kentucky	Texas
Maine	Washington
Maryland	Wisconsin
Michigan	Wyoming

None of the states in the above list have any laws or codes governing the construction of school buildings at the present time (January, 1915), although some of the states in this list have laws requiring drawings and specifications for school buildings to be submitted to the state boards of health or the state factory inspector for approval before the buildings are constructed. These conditions obtain in Vermont and one or two other states. However, no state in the above list has now any requirements whatever regarding the heating and ventilating, lighting, sanitation, fireproofing or panic proofing of school buildings.

In all of these states, notably Missouri and Illinois, the large cities like St. Louis and Chicago have city building codes,

the provisions of which apply to school buildings in common with all other buildings, but as a rule such city building ordinances relate only to safety of construction, and to fire protection.

THE CONNECTICUT LAW

Every school house shall be kept in a cleanly state and free from effluvia arising from any drain, privy, or other nuisance, and shall be provided with a sufficient number of proper water closets, earth closets, or privies, for the use of the pupils attending such school house, and shall be properly ventilated.

Whenever it shall be found by the state board of education, or by the board of school visitors, or by a member of the town school committee of the town in which any school house is located, that further or different sanitary provisions or means of lighting or ventilating are required in any school house, and that the same can be provided without unreasonable expense, either of said boards, or such member of the town school committee may recommend to the person or authority in charge of or controlling such school house such changes in the ventilation, lighting, or sanitary arrangements of such school house as they may deem necessary. In case such changes be not made substantially as recommended within two weeks from the date of notice thereof such board or member of the committee may make complaint to the proper health authority of the community in which such school house is situated, which said authority shall, after notice to and hearing of the parties interested, order such changes made in the lighting, ventilation or sanitary arrangements of such school house as it may deem necessary and proper.

All public school houses, the construction of which was not begun before the passage of this act, shall be constructed in accordance with the provisions hereof.

No school house for the accommodation of pupils of grammar school grade, or of a lower grade, shall be constructed so as to contain more than two stories above the basement.

No school house for the accommodation of pupils of a higher grade than grammar school grade shall be constructed so

as to contain more than two stories above the basement, unless such school house is of fire-proof construction throughout, and in that event shall not exceed three stories above the basement.

All school houses of eight or more class-rooms not of fire-proof construction throughout shall be built as follows:

(a) The outer walls shall be of brick, natural or artificial stone, terra cotta blocks, re-enforced concrete, or other fire-proof material.

(b) The walls separating the school rooms from the halls or corridors shall be of masonry or other fire-proof material.

(c) There shall be a stairway constructed in at least two opposite sides of the building leading to the ground floor from the floor or floors above, and no such school house hereafter built shall contain circular stairs.

(d) There shall be one exit constructed in at least each of two opposite sides of the building upon the first floor leading to the ground, which may be the same as the exits from the floor or floors above the first.

(e) The stairs and stairways shall be of fire-proof construction.

(f) All doors leading from rooms into halls or corridors shall be hung so as to swing into the hall or corridor, and all doors leading from the corridors out of the building shall be so hung as to swing outward.

(g) There shall be a door of fire-proof material at the head of each stairway leading from the first floor to the basement.

(h) All wooden partitions, ceilings, floors, and woodwork about the heating apparatus or plant shall be covered with asbestos, tin, sheet iron, or other fire-proof material so as to effectually overcome danger from fire.

No door leading from a school room into a hall or corridor, or from a hall or corridor out of the building shall, during school hours, be locked or bolted or secured in any other manner than by a spring which will readily yield to pressure from the inside.

There shall be placed in a hall or corridor of every such school an alarm consisting of a bell or gong arranged or equipped so as to be sounded from at least one convenient station or place upon each floor and of sufficient size and volume of tone to be distinctly heard in every room when sounded. In the absence of such alarm there shall be placed in each room an alarm consisting of a bell or gong of sufficient volume to be heard throughout the room where placed, all or simultaneously from the same station or place, at least one of which stations or places shall be conveniently located in a hall or corridor upon each floor.

The following act regulates the employment of architects on public buildings:

SECTION 1. Whenever any building is to be erected by the State of Connecticut in the designing or construction of which the services of an architect shall be required, the comptroller shall give public notice, for not less than one month, through the public press, that such public building is to be erected, together with a statement of the amount appropriated therefor and other details of the proposed construction, and that any and all architects who may see fit may submit plans, specifications, and estimates of cost for the construction of such building.

SECTION 2. Upon application to the comptroller by any architect, the comptroller shall give such additional information regarding such contemplated building and its character, construction, and details as he may possess.

SECTION 3. All plans, specifications, and estimates for such building, submitted to the comptroller, shall be received by him and by him delivered into the custody of the board of control or, in case a committee is raised, or persons appointed by the general assembly to have charge of the supervision or construction of such building, then to such committee or persons, which board, committee, or persons shall receive and inspect all of such plans and specifications.

SECTION 4. Said board, committee, or persons having charge of the supervision or construction of such building and the selection of plans and specifications therefor, shall give a

public hearing to all parties interested, who shall have ample opportunity to present the merits of any of said plans and specifications.

Section 5. Said board, committee, or persons shall have the right to accept and adopt any one of the said plans and specifications, and may reject any or all of them, and such selections shall be conclusive.

Any janitor, teacher, or other person who violates the provisions of 311 shall be fined not more than three hundred dollars, or imprisoned not more than three months, or both. Every member of a board of education, school board, board of school visitors, or building committee, or official who is charged with the duty of planning, contracting for, or building a public school house, who plans or contracts, or participates in contracting for, or votes to build, or builds such school house in violation of any of the provisions of 308-309 shall be fined not more than three hundred dollars, or imprisoned not more than three months, or both.

Every story above the first story of a building used as a school house, orphan asylum, insane asylum, reformatory, opera house, hall for public assemblies, boarding house accommodating more than twelve persons, or tenement house occupied by more than five families shall be provided with more than one way of egress, by stairways on the inside or fire escapes on the outside of such building. Said stairways and fire escapes shall, at all times, be kept free from obstruction and shall be accessible from each room in every story above the first story.

Every theater, nickelette, school house, or hall, excepting town halls, in which people commonly assemble in larger numbers than one hundred, shall be provided with one or more exits, each exit consisting of a door so hung as to open outward, and in case any passageway from such theater, nickelette, school house, or hall to such exit contains one or more doors, each door shall be so hung as to open outward.

The owner or lessee of any such theater, nickelette, school house, or hall who uses or permits any such theater, nickelette,

school house, or hall to be used as a place for the assembly of people when such theater, nickelette, school house, or hall does not conform to the provisions of this act shall be fined not more than two hundred dollars, or confined in jail not more than six months, or both. If the owner or lessee is a corporation, the directors shall be deemed the owners or lessees within the meaning of this act. If the owner or lessee is an ecclesiastical society or a school district, the trustees of such society or the board having control of the property or of such school house shall be deemed the owner or lessee within the meaning of this act.

THE INDIANA LAW

DOORS MUST SWING OUTWARD

243. Whoever, being the owner, manager, lessee, trustee, or person having the charge of any theater, opera house, museum, college, seminary, church, school house, or other public building, refuses or neglects to cause all the doors thereof, constructed for the purpose of ingress and egress, whether inner or outer doors, to be so hung that the same shall swing outwardly, shall be fined in any sum not exceeding one thousand dollars nor less than ten dollars, to which may be added imprisonment in the county jail for any period not exceeding six months: Provided, that this section shall not apply to the outer doors of one-story churches and school houses.

SANITARY BUILDINGS

1. That after the going into effect of this act, all school houses which shall be constructed or remodeled, shall be constructed in accordance and conform to the following sanitary principles, to-wit:

(a) *Sites.*—All sites shall be dry, and such drainage as may be necessary to secure and maintain dry grounds and dry buildings, shall be selected and supplied. Said site and said buildings shall not be nearer than 500 feet to steam railroads, livery stable, horse, mule or cattle barn used for breeding purposes or any noise-making industry or any unhealthful condi-

tions. Good dry walks shall lead from the street or road to every school house and to all outhouses, and suitable play grounds shall be provided.

(b) *Buildings.*—School buildings, if of brick, shall have a stone foundation, or the foundation may be of brick, or concrete: Provided, a layer of slate, stone or other impervious material, be interposed above the ground line, or the foundation may be of vitrified brick and the layer of impervious material will not be required. Every two-story school house shall have a dry, well-lighted basement under the entire building, said basement to have cement or concrete floor and ceiling to be not less than ten feet above the floor level. The ground floor of all school houses shall be raised at least three feet above the ground level and have, when possible, dry, well-lighted basement under the entire building, and shall have a solid foundation of brick, tile, stone or concrete, and the area between the ground and the floor shall be thoroughly ventilated. Each pupil shall be provided with not less than 225 cubic feet of pace, and the interior walls and ceiling shall be either painted or tinted some neutral color as gray, slate, buff or green.

(c) *Lighting and Seating.*—All school rooms where pupils are seated for study, shall be lighted from one side only and the glass area shall be not less than one-sixth of the floor area and the windows shall extend from not less than four feet from the floor to at least one foot from the ceiling, all windows to be provided with roller or adjustable shades of neutral color as blue, gray, slate, buff or green. Desks and desk seats shall preferably be adjustable, and at least twenty per cent of all desks and desk seats in each room shall be adjustable, and shall be so placed that the light shall fall over the left shoulders of the pupils. For left-handed pupils, desks and seats may be placed so as to permit the light to fall over the right shoulder.

(d) *Blackboards and Cloak Rooms.*—Blackboards shall be preferably of slate, but of whatever material, the color shall be a dead black. Cloak rooms, well lighted, warmed and ven-

tilated, or sanitary lockers, shall be provided for each study school room.

(e) *Water Supply and Drinking Arrangements.*—All school houses shall be supplied with pure drinking water and the water supply shall be from driven wells or other source approved by the health authorities. Only smooth, stout glass or enameled metal drinking cups shall be used; water buckets and tin drinking cups shall be unlawful and are forbidden; and whenever it is practicable, flowing sanitary drinking fountains which do not require drinking cups, shall be provided. All school house wells and pumps shall be supplied with troughs or drains to take away waste water, and under no conditions shall pools or sodden places or small or large mud holes be allowed to exist near a well. When water is not supplied at pumps or from water faucets or sanitary drinking fountains, then covered tanks or coolers supplied with spring or self-closing faucets shall be provided.

(f) *Heating and Ventilation.*—Ventilating heating stoves, furnaces, and heaters of all kinds, shall be capable of maintaining a temperature of 70 degrees Fahrenheit in zero weather and of maintaining a relative humidity of at least 40 per cent; and said heaters of all kinds shall take air from outside the building and after heating, introduce it into the school room at a point not less than five nor more than seven feet from the floor, and at a minimum rate of thirty (30) cubic feet per minute for each pupil regardless of outside atmospheric conditions: Provided, that when direct-indirect steam heating is adopted, this provision as to height of entrance of hot air shall not apply. Halls, office rooms, laboratories and manual training rooms, may have direct steam radiators, but direct steam heating is forbidden for study school rooms, and direct-indirect steam heating is permitted. All school rooms shall be provided with ventilating ducts of ample size to withdraw the air at least four times every hour, and said ducts and their openings shall be on the same side of the room with the hot air ducts.

(g) *Water-closets and Outhouses.*—Water-closets or dry closets when provided, shall be efficient and sanitary in every particular, and furnished with stalls for each hopper or place, and when said water or dry closets are not provided, then sanitary outhouses, well separated for the sexes, shall be provided. Good dry walks shall lead to all outhouses and screens or shields be built in front of them. Outhouses for males shall have urinals arranged with stalls and with conduits of galvanized iron, vitrified drain pipe, or other impervious material, draining into a sewer, vault or other suitable place, approved by the health authorities. Any school trustee or trustees, who shall build or construct any school house or cause to be built or constructed any school house which does not include each and every sanitary provision commanded in this act, shall, upon conviction, be fined in any sum not less than one hundred nor more than five hundred dollars; and any money claim for the material entering into, or any money claim for the construction of any school house, which does not in every way and all respects comply with the requirements of this act, shall be null and void.

BUILDINGS—FIRE—MEANS OF ESCAPE

1. Every building now or hereafter used in whole or in part as a public building, public or private institution, sanitarium, surgical institute, asylum, school house, dormitory, church, theater, public hall, place of assemblage or place of public resort, and every building in which persons are employed above the second story in a factory, workshop, or mercantile or other establishment, and every hotel, family hotel, apartment house, boarding house, lodging house, club house or tenement house, in which persons reside or lodge above the second story, and every factory, workshop, mercantile or other establishment of more than two stories in height, shall be provided with proper ways of egress or means of escape from fire, sufficient for the use of all persons accommodated, assembled, employed, lodged or residing in such buildings, and such ways of egress and means of escape shall be kept free from obstruction, in good repair and ready for use

at all times, and all rooms above the second story in such building shall be provided with more than one way of egress or escape from fire, placed as near as practicable at opposite ends of the room and leading to fire escape on the outside of such building or to stairways on the inside, provided with proper railings. All outside doors subject to the provisions of this section shall open outward, and all windows open outward or upward. No chairs or seats shall be allowed in the aisles or passways of such building during any entertainment or service, or when people are assembled therein, and no one shall interfere with any peace officer in attempting to enforce the provisions of this act. The proscenium, or curtain opening, of all theaters shall have a fire-resisting curtain of some incombustible material, and such curtain shall be properly constructed and shall be operated by proper mechanism. The certificate of the fire chief of the city where said building is located, certifying that the provisions of this act have been complied with, shall be prima facie evidence of a compliance with such requirements.

FIRE ESCAPES

2. In addition to the foregoing means of escape from fire, all such buildings as are enumerated in section 1 of this act as are more than two stories in height shall have one or more fire escapes on the outside of said building, as may be directed by the fire chief aforesaid, except in such cases as said fire chief may deem such fire escape to be unnecessary in consequence of adequate provisions having been already made for the (sic) safety in event of fire, and in such cases of exemption the said fire chief shall give the owner, lessee or occupant of said building a written certificate to that effect and his reasons therefor, and such fire escapes as are provided for in this section shall be constructed according to specifications issued by (the) state department of inspection and accepted by the chief inspector, or approved by the fire chief, and shall be connected with each floor above the first, well fastened and secured by extending the bolts or fastenings entirely through the walls, and of sufficient

strength, each of which fire escapes shall have landings or balconies guarded by iron railings not less than three feet in height, and embracing one or more windows at each story and connecting with the interior by easily accessible and unobstructed openings, and all the balconies or landings shall be connected by iron stairs, placed at a slant of not more than forty-five degrees, protected by a well secured hand rail on both sides, with a sixteen-inch- wide drop ladder from the lower platform, reaching to the ground; except in cases of school buildings iron stairs shall extend to a ground landing, and no telegraph, telephone, electric light poles, trees or wire, signs or other obstructions shall interfere with the construction and use of any fire escape.

PLAN OF ESCAPES—APPROVAL

3. Any other plan or style of fire escape shall be sufficient if approved by the chief inspector, but if not so approved the chief inspector may notify the owner, proprietor or lessee of such establishment or of the building in which such establishment is conducted, or the agent or superintendent, or school officer, or either of them, in writing, that any such plan or style of fire escape is not sufficient, and may by an order in writing, served in like manner, require one or more fire escapes as he shall deem necessary and sufficient to be provided for such establishment at such location, and (of) such plan and style as shall be specified in such written order. Within twenty days after the service of such order the number of fire escapes required in such order for such establishment shall be provided therefor, each of which shall be of the plan and style in accordance with the specifications in said order required. The windows or doors to each fire escape shall be of sufficient size and be located, as far as possible, consistent with accessibility from the stairways and elevators, hatchways or openings, and the ladder thereof shall extend to the roof. Stationary stairs or ladders shall be provided on the inside of such establishment from the upper story to the roof as a means of escape in case of fire.

THE KANSAS LAW

Be it enacted by the Legislature of the State of Kansas:

DOORS IN SCHOOL HOUSES

That the doors of all public or private school houses of more than one story shall open outwards, and all doors of school houses shall remain unlocked while school is in session.

SEPARATE EXITS

That in every public or private school house of two or more stories every story above the first shall be provided with either two or more exits from the upper floor, separate and distinct from the exits of the lower floor, or shall be provided with sufficient and suitable fire escapes, which shall be built of iron or steel.

FURNACES

That the tops of all furnaces in public or private school houses shall be covered with asbestos covering or masonry, and the top of such furnace shall not be nearer than eighteen inches to the nearest woodwork above. The ceiling above said furnace shall be covered with asbestos.

PLANS—STATE ARCHITECT

That no contract shall be let for the erection of any school building, nor shall any public funds be paid out for the erection of school houses of two or more stories, until the plans for such buildings shall have been submitted to the state architect and approved as to all the requirements of this act.

INSPECTIONS

That each county superintendent shall annually inspect each public school building, including the county high school building, in districts under his supervision; and the mayor or fire marshal shall annually inspect all public and private school buildings in cities of the second class; and the fire marshal shall annually inspect all public and private school buildings in cities of the first class. The examining officer under this section shall report

to the respective school boards having jurisdiction any violation of this act, or any conditions which he may deem dangerous, or which will in any way prevent a speedy exit from the building, and it shall be the duty of said school board when thus notified immediately to make such changes as are required by this act, and such boards are hereby authorized to draw upon their general revenue funds, without further appropriation, to comply with all requirements of this act.

FIRE DRILLS

That in every public or private school having more than one hundred pupils (excepting colleges and universities) a fire drill and summary dismissal from the building shall be practiced at least once each month at some time during school hours, aside from the regular dismissal at the close of the day's session.

PENALTIES

That any officer or member of a school board who shall permit any provision of this act to be violated for sixty days may be removed from his office by a civil action. Independent of such civil action, any officer, member of a school board, city superintendent, principal or teacher violating any provision of this act shall be guilty of a misdemeanor, and shall be punished by a fine of not less than fifty dollars or more than five hundred dollars, or by imprisonment in jail not exceeding six months, or by both such fine and imprisonment; provided, however, that this act shall not prevent the prosecution and punishment of an officer or other person under the ordinary provisions of the crimes act for death or injury to any child in a public or private school occasioned by the negligence of such officer or other person.

WHEN EFFECTIVE—PENALTIES

That within sixty days after the taking effect of this act the provision of section 1 of this act must be fully complied with, and within one hundred and twenty days the provisions of sections 2 and 3 must be complied with; and any neglect to comply with the provisions of this act beyond the times herein specified

shall subject the officers and persons named in this act to the penalties prescribed in this act.

This act shall take effect and be in force from and after its publication in the statute book.

Approved February 23, 1909.

Published May 29, 1909.

LOUISIANA LAW

NOTE:—By Act 192 or 1898 the state board of health is authorized to enact regulations which are binding upon the public.

PARISH BOARD AND SUPERINTENDENT TO ENFORCE RULES AND REGULATIONS

The parish or municipal school board, and the parish superintendent of schools shall be held responsible for the execution and enforcement of the following rules and regulations, and all other health laws governing the hygiene of the school room and the premises of the schools under their respective jurisdictions.

PLANS FOR SCHOOL HOUSES TO BE SUBMITTED TO STATE SUPERINTENDENT, PARISH SUPERINTENDENT AND PARISH HEALTH OFFICER

Plans and specifications for every school house hereafter erected in the state must be submitted to the parish superintendent of schools, and to the state superintendent of education, and also to the parish health officer, that it may be determined whether every hygienic or necessary provision is made, especially with reference to ventilation, light and protection against fire.

REGULATING VENTILATION AND LIGHT

Every school house, public or private, or other building used for school purposes, shall be ventilated in such manner as to afford eighteen hundred cubic feet of air per hour for each adult, and a proportionate amount for each child, and shall contain not less than two hundred cubic feet of air space for each

child to be taught therein. Windows and transoms shall be so constructed that windows may be lowered from the top and transsoms opened. Every school house must be lighted in such a manner as to minimize the eye strain. Each room must contain of actual surface of glass in windows not less than one-seventh of the floor space.

REGULATING THE SWINGING DOORS

All doors except those which slide into wall pockets shall open outward and all partition doors shall be hung on double-action hinges.

GOVERNING THE TREATMENT AND SWEEPING OF FLOORS AND WIPING OF FURNITURE, ETC.

The floors of every school must be treated with some antiseptic floor dressing. Applications to be at sufficiently frequent intervals to keep down effectually the dust; floors to be scrubbed thoroughly before each application. Floor dressing for use in the schools must be approved by the state analyst.

The floors of every school must be swept daily, sweeping to be done after all pupils have left the building. All windows must be thrown open and school house thoroughly aired after cleaning.

All desks, wainscoting, window sills and baseboards in every school house in the state must be wiped off daily with a cloth moistened with 1-2000 bichloride of mercury, or 3 per cent carbolic acid solution.

SPITTING ON FLOORS STRICTLY PROHIBITED

Spitting on floors, walls, etc., must be strictly prohibited and anti-spitting placards placed in every room.

MASSACHUSETTS LAW

In the State of Massachusetts, school and all other public buildings are under the authority of the inspection department of the district police, whose inspectors are required to enforce

the laws regarding factories and public buildings. The city of Boston has a school house commission consisting at the present time (January 1st, 1914) of three persons: R. Clipston Sturgis, Jas. B. Noyes and Tilton S. Bell.

This commission has full charge of the school buildings in the city of Boston, determines the character of buildings to be erected for school purposes, selects the architects and approves the drawings and specifications used for the construction of such buildings, and has prepared a very elaborate and itemized building code, relating to school buildings for the city of Boston, based on the experience and researches of the members of the commission, as well as the experience gained from the construction of many buildings in recent years. It is believed that this code represents the very acme of public school requirements at the present day, and may safely be considered as authoritative, proper allowance being made for local modifications and conditions necessary in the different parts of the country. This code is reproduced in full by permission from the 1914 report of the Boston School House Commission among the following codes.

STATE LAW

Form of specification to accompany plans for public buildings and school houses.

This form is intended to give architects and others general information as to what is required by law and the regulations of this department, and, if fully filled out, may be accepted by the inspector in place of a copy of the building specifications, but full detail specifications may be required if deemed essential to a clear understanding of the plans.

The law requires that a copy of the plans of every public building and every school house (except in the city of Boston) shall be deposited with the inspector of factories and public buildings of the district in which such building is located, before the erection of the building is begun, which plans shall also include the system or method of ventilation to be provided, together with such portion of the specification as the inspector may require.

The plans usually required are a plan of each floor, including the basement and the attic, if the attic is occupied, and a front and a side elevation, and also plans and sectional detail drawings of the system of ventilation. Further plans may be required by the inspector if deemed by him to be necessary.

In planning buildings to be used for school rooms, or places of assemblage above the first story, provision should be made for at least two stairways, and such stairways should be as far apart as practicable. No such stairway should be less than four feet wide in the clear, and winding steps should be avoided. The height of rise and width of tread of all stairs, measured on the cut of the stringer, should be given on the plans. No flight of stairs should be more than fifteen steps between landings.

The main stairways from places of assemblage should have a width of not less than twenty inches for every hundred persons accommodated there. Such stairways should be railed on both sides. All outside doors to such buildings should open outwardly, and be plainly so shown on plans. The standing leaf of all pairs of doors leading to ways of egress should be fastened by face bolts, operated at top and bottom by one handle, at a convenient height from the floor.

In the ventilation of school buildings the many hundred examinations made by the inspector of this department have shown that the following requirements can be easily complied with:

1. That the apparatus will, with proper management, heat all the rooms, including the corridors, to 70 degrees F. in any weather.

2. That, with the rooms at 70 degrees and a difference of not less than 40 degrees, between the temperature of the outside air and that of the air entering the room at the warm-air inlet, the apparatus will supply at least thirty cubic feet of air per minute for each scholar accommodated in the rooms.

3. That such supply of air will so circulate in the rooms that no uncomfortable draught will be felt, and that the dif-

ference in temperature between any two points on the breathing plane in the occupied portion of a room will not exceed 3 degrees.

4. That vitiated air in amount equal to the supply from the inlets will be removed through the ventiducts.

5. That the sanitary appliances will be so ventilated that no odors therefrom will be perceived in any portion of the building.

To secure the approval of this department of plans showing methods or systems of heating and ventilation, the above requirements must be guaranteed in the specifications accompanying the plans.

MINNESOTA LAW

NOTE: The State of Minnesota has no definite law or code governing the construction of school buildings, but all plans for school buildings in the State of Minnesota must be prepared in accordance with the regulations of the State Board of Health which are as follows:

No school room, or class room, except an assembly room, shall have a seating capacity that will provide less than eighteen square feet of floor space and 216 cubic feet of air space per pupil, and no ceiling in buildings hereafter to be erected shall be less than twelve feet from the floor.

A system of ventilation, in order to be approved by the Minnesota State Board of Health, shall furnish not less than thirty cubic feet of air per minute for each person that the room will accommodate, when the difference of the temperature between the outside air and the air in the school room shall be thirty degrees F. or more.

In a gravity system of ventilation, in connection with a furnace or steam plant, the flues for admitting fresh air to the room, as well as the vent flues, shall have a horizontal area of not less than one square foot for every nine persons that the room will accommodate.

The flues for a "plenum" or "vacuum" system of ventilation shall have a horizontal area of not less than one square foot for every fifteen persons that the room will accommodate.

The window space shall equal one-fifth of the floor space of the school room.

In all rooms not exceeding twenty-five feet in width all the light shall be admitted to the left of the pupils.

In rooms exceeding twenty-five feet in width, light shall be admitted to the left and rear of the pupils.

Translucent instead of opaque shades shall be used in the windows for controlling the light.

The top of the windows shall be as near the ceiling as the mechanical construction of the building will allow.

No cloak room shall be less than six feet wide, nor shall it have less than one window.

The so-called "Sanitary wardrobe" which allows the foul air of the room to pass through the clothing of the children before passing into the vent duct, shall be condemned as unsanitary.

THE NEW HAMPSHIRE LAW

BUILDINGS, ETC., IN CITIES

No schoolhouse shall be erected, altered, remodeled, or changed in any city school district, unless the plans thereof have been previously submitted to the school board of that district and received its approval, and all new school houses shall be constructed under the direction of a joint special committee, chosen in equal numbers by the city councils and the school board.

Upon the completion of a new school house, the city councils shall, by vote, transfer it to the care and control of the school board. Whenever a schoolhouse shall no longer be needed for public school purposes, the school board shall re-transfer its care and control to the city.

DOORS TO OPEN OUTWARD

The outer doors and doors of passage leading outward, of churches hereafter built or rebuilt, school house containing more

than two school rooms, and halls and other buildings used for public gatherings, shall open outward; and it shall be the duty of the selectman of towns to see that these provisions are complied with, and to prosecute persons who neglect to do so.

NEW JERSEY LAW

STATE BOARD OF EDUCATION

The State Board of Education shall have power:

To frame and modify by-laws for its own government; to elect its president and other officers, and to prescribe and enforce rules and regulations necessary to carry into effect the school laws of this State.

Appoint an Inspector of Buildings, who who shall devote his time during the entire twelve months in the year to visiting the schools in the State and to making a thorough report with regard to each.

COMMISSIONER OF EDUCATION

The Commissioner of Education shall be the Secretary of the State Board of Education, and a member, ex-officio, of all boards of examiners. He shall enforce all rules and regulations prescribed by the State Board of Education. He shall have supervision of all the schools of the State receiving any part of the State appropriation. He shall, from time to time, instruct County and City Superintendents as to their duties and as to the best manner of conducting schools, constructing schoolhouses and furnishing the same.

The Commissioner of Education may direct the entire or partial abandonment of any building used for school purposes and may direct the making of such changes therein as to him may seem proper.

The Commissioner of Education shall decide, subject to appeal to the State Board of Education and without cost to the parties, all controversies and disputes that shall arise under the school laws, or under the rules and regulations of the State Board of Education. The facts involved in any controversy or dispute shall, if he shall so require, be made known to him by

written statements by the parties thereto, verified by oath or affirmation, and accompanied by certified copies of all documents necessary to a full understanding of the question in dispute, and his decision shall be binding until, upon appeal, a decision thereon shall be given by the State Board of Education.

The Commissioner of Education shall keep a record of all his official acts and shall preserve copies of all decisions made by him, and shall adopt and provide an official seal. Copies of all acts, orders and decisions made by him, and of all papers deposited or filed in the Department of Public Instruction may be authenticated under said seal, and, when so authenticated, shall be evidence equally with and in like manner as the originals.

In case a Board of Education, or any officer thereof, or the legal voters of any school district, or any board or officer of the municipality in which any such school district shall be situate shall neglect or refuse to perform any duty imposed upon such board, officer or legal voters by this act or by the rules and regulations of the State Board of Education, the custodian of the school moneys of such school district shall, upon notice from the County Superintendent of Schools, approved by the Commissioner of Education, withhold all moneys received by him from the County Collector and then remaining in his hands to the credit of such district, until he shall receive notice from said County Superintendent of Schools that said board, officer or legal voters have fully complied with the provisions of this act and with the rules and regulations of the State Board of Education.

The Commissioner of Education shall prepare and cause to be printed forms for making all reports and conducting all proceedings under the school laws of this State. He shall cause all school laws to be printed in pamphlet form, and shall annex thereto forms for making reports and conducting school business, and shall distribute the same.

COUNTY SUPERINTENDENTS

A County Superintendent of Schools shall have power:

To exercise general supervision over the public schools of the county under his charge in accordance with the rules and

regulations prescribed from time to time by the State Board of Education; to visit and examine all the schools under his care; to inquire into the management, methods of instruction and discipline in such schools; to note the condition of the schoolhouses, sites, buildings and appurtenances; to examine the courses of study, textbooks and school libraries; to advise with and counsel Boards of Education in relation to their duties, particularly in respect to the construction, heating, ventilating and lighting of schoolhouses, and to recommend to Boards of Education and teachers proper studies, methods, discipline and management for the schools.

SCHOOLHOUSES, FACILITIES AND ACCOMMODATIONS—NEW JERSEY

Each school district shall provide suitable school facilities and accommodations for all children residing in the district and desiring to attend the public schools therein. Such facilities and accommodations shall include proper school buildings, together with furniture and equipment, convenience of access thereto, and courses of study suited to the ages and attainments of all pupils between the ages of five and twenty years. Such facilities and accommodations may be provided either in schools within the district convenient of access to the pupils or as provided in sections one hundred and seventeen, one hundred and eighteen and one hundred and nineteen of the act to which this act is an amendment. Whenever any school district shall fail to provide such facilities or accommodations, the County Superintendent of Schools shall transmit to the custodian of the school moneys of the school district an order directing him to withhold from such district all moneys in his hands, or which shall thereafter come into his hands, to the credit of such school district received from the State appropriation or from the State school tax until such suitable facilities or accommodations shall be provided, and shall notify the Board of Education of such district of his action with the reasons therefor. Such order shall not take effect until ap-

proved in writing by the Commissioner of Education, and said approval shall state when said order shall take effect.

Each Board of Education shall provide at least two suitable and convenient out-houses or water-closets for each of the schoolhouses under its control. Said out-houses or water-closets shall be entirely separated each from the other and shall have separate means of access. Said out-houses and said water-closets, if detached from the schoolhouse, shall be separated by a substantial close fence not less than seven feet in height. The Board of Education shall have said out-houses and water-closes kept in a clean and wholesome condition. The question of raising the amount needed to carry into effect the provisions of this section shall not be submitted to the legal voters of the school district, but the Board of Education shall notify the assessor or assessors and collector, by notice signed by the president and district clerk or secretary, of the amount needed for such purpose, and such amount shall be assessed, levied and collected at the same time and in the same manner as other special school taxes are assessed, levied and collected.

The Commissioner of Charities and Corrections shall, upon the request of the Commissioner of Education, cause to be prepared standard plans and specifications for school buildings to contain one, two, four, six, eight, twelve, sixteen, twenty and twenty-four rooms. The Commissioner of Education shall, upon receipt of such plans and specifications, cause blueprints to be made of the plans, and shall have printed copies of the specifications and shall loan copies to any district upon its application. The Commissioner of Charities and Corrections shall also, upon the request of the Commissioner of Education, cause to be made a thorough examination of any school building and to report to the Commissioner of Education his findings in regard thereto.

No contract for the erection of any public school building or any part thereof shall be made until and after plans and specifications therefor have been submitted to and approved by the State Board of Education. A copy of the plans and specifications as approved shall be filed forthwith with the State Board

of Education. A copy of the contracts for the erection of the whole or any part of the school building and for the furnishing thereof shall be filed with the State Board of Education within ten days after the same have been signed. No change in the plans or specifications shall be legal unless the same have been submitted to and approved by the State Board of Education. A copy of all changes as approved shall be filed forthwith with the said Board.

RULES AND REGULATIONS OF STATE BOARD OF EDUCATION—NEW JERSEY

Revised to August 15, 1914

In order that the lives, health, sight, and comfort of pupils may be properly protected, all schoolhouses hereafter erected shall comply with the following conditions.

When existing schoolhouses are enlarged these provisions shall apply only to the added portion. It is recommended, however, that the old portion of such buildings shall conform to the provisions of the Code as far as practicable. Correspondence is invited from districts considering the enlarging or remodeling of existing schoolhouses.

DEFINITION OF CLASSROOM

Whenever the word "classroom" is used it is construed to mean "all rooms in a school building used by the pupils for classroom or study purposes" (exclusive of gymnasium, assembly rooms and manual training rooms).

LIGHT

Unilateral Lighting

The windows in all classrooms shall be so arranged that the light shall come from the pupils' left. If desirable to have more window space, the supplemental light shall come from the rear. The windows shall be grouped together as nearly as possible on the pupils' left. The windows shall extend as near to the ceiling as the principles of construction will admit, and must be without transoms or unnecessary framework. Any con-

siderable area on the side to the left of the pupils that is without window surface should be opposite the space in front of or in the rear of the pupils' desks. The total glass area on the pupils' left side, exclusive of mullions, stiles, rails and check rails, must equal at least 20 per cent of the floor surface.

PRISMATIC GLASS

A 10 per cent deficiency in the required glass area of a classroom may be corrected by the use of prism glass in the upper sash of windows.

BAY WINDOWS

Bay windows will not be permitted in classrooms, except those used for kindergarten purposes exclusively.

LABORATORIES AND LIBRARIES

Laboratories and libraries shall have glass area equal to at least 20 per cent of the floor space; this light may come from any direction.

VENTILATION

Each classroom shall have at least 18 square feet of floor space and 200 cubic feet of air space for each pupil to be accommodated in such classroom. All school buildings shall have a system of ventilation by means of which each classroom shall be supplied with fresh air at the rate of not less than 30 cubic feet per minute per pupil. Approved ventilating stoves will be allowed in all one-story school buildings, and in all school buildings in which the number of rooms does not exceed two.

The State Board of Education strongly recommends the installation of a mechanical system of ventilation, operating by electricity, gas, steam or other motive power, in all buildings of four or more rooms, and of two or more stories in height, as experience shows that gravity ventilation is unreliable.

HEAT AND VENT FLUES

All fresh and foul air ventilating flues and ducts must be of fireproof material and the flues and ducts shall not come in contact with wood construction.

HEAT

The heating plant must be capable of heating all parts of the building to a uniform temperature of 70 degrees in zero weather with the ventilating system furnishing the required amount of fresh air in each classroom.

HEATER ROOMS

All boiler and furnace rooms shall be enclosed by fireproof walls, floors and ceilings, and all doors shall be of Underwriters' approved type firedoors, tin-clad, hung with proper equipment to keep them closed. The ceiling or floor construction over said rooms shall be of reinforced concrete or standard fireproof hollow arched tile and steel beam construction, designed to be absolutely fireproof and capable of sustaining a live load of 100 pounds per square foot.

SUGGESTIONS FOR PLACING BLACKBOARDS

The importance of blackboards in the daily work of the school is often very much underrated by school boards and architects. This matter is now generally well planned in new buildings in cities, but in country districts it is not unusual to find blackboards of very poor quality and unnecessarily limited in amount.

All available space in the front of the schoolroom and on the right hand side of pupils should be given to blackboards.

These boards should be of slate and of good quality.

They should be 4 feet wide (from top to bottom).

A chalk trough 3 inches wide should be placed along the lower edge of all boards.

The following directions for placing blackboards have been issued by the U. S. Bureau of Education.

ONE-ROOM BUILDINGS

Grades I—VII

Board on front wall—32 inches above floor.

Board on side wall—26 inches above floor.

TWO-ROOM BUILDINGS

Grades I—IV

Board on front wall—26 inches above floor.

Board on side wall—26 inches above floor.

Grades V—VIII

Board on front wall—30 inches above floor.

Board on side wall—30 inches above floor.

TWO-STORY BUILDINGS

All school buildings two stories in height, and of more than four classrooms above the first floor, shall have enclosing walls of hard burned brick, stone or concrete.

THREE-STORY BUILDINGS

All school buildings of three or more stories in height shall be of fireproof construction. The doors, windows, window frames, roof rafters and trusses, trim, finished floors and other interior finish may be of wood.

BASEMENTS

When a school building has a basement, the ceiling of which is 7½ feet or more above the finished grade line at any point, such basement shall constitute a story, and will be so considered in determining the number of stories in such school building.

AUDITORIUMS

A building having an auditorium or classroom on the third floor is considered a three-story building.

It is strongly recommended that auditoriums be placed on the first floor. All auditoriums shall have ample means of exit, leading direct to the street. Unless especially approved, auditoriums will not be allowed on the second floor if their seating capacity is 500 or more persons.

FLOOR BEAMS

The following is a schedule of the size of unsupported floor beams and the maximum spans of such unsupported floor beams that will be permitted.

Hemlock: Spans over 18 feet and up to 20 feet, inclusive, 2 x 12 spaced 16 inches on center.

Spruce: Spans over 20 feet and up to 22 feet, inclusive, 3 x 12 spaced 12 inches on center.

Spruce: Spans over 22 feet and up to 24 feet, inclusive, 3 x 14 spaced 12 inches on center.

Yellow Pine: Spans over 24 feet and up to 26 feet, inclusive, 3 x 14 spaced 16 inches on center.

Yellow pine: Spans over 26 feet and up to 30 feet, inclusive, 3 x 14 spaced 12 inches on center.

All spans shall be bridged with 2 x 3 herring-bone bridging not less than 8 feet apart.

TERRA COTTA TILE WALLS

Hollow tile may be used for exterior and interior bearing walls which receive directly the loads from floors or roofs, in addition to their acting as partition walls, in buildings not more than two stories in height, provided the load does not exceed 200 pounds per square inch of effective bearing parts. The thickness of such walls shall not be less than would be required for brick walls. The thickness of walls shall be calculated as the outside dimension of the tile (exclusive of plaster and stucco) and each tile shall be the full thickness of the wall.

All tile used in bearing walls shall be laid with the voids running vertically (except an approved interlocking tile) and shall be laid in mortar composed of 1 part Portland cement, 2½ parts sand and not more than 1-10 (bulk measurement) of hydrated lime.

No blocks will be approved that do not develop a compressive strength of at least 3500 pounds per square inch of net section; and in no case shall the voids exceed 50 per cent of the gross sectional area.

All blocks used in outside walls must be dense and well burned, and shall not absorb more than 1-10 (10 per cent) of their weight in water after immersion two hours, and must have a clear ringing sound when struck.

No tile shall be used in any bearing walls below the first floor of beams.

Hollow tile may be faced with brick, or stuccoed after being made damp-proof by approved methods. If faced with brick, such brick facing shall not be considered as performing any constructive function unless such brickwork is properly bonded to the tile walls by a continuous course of brick headers at least every 2 courses in height of tile, or every 7th course of brickwork, if the tiles are of such size as will permit.

Header course of flemish bond will be approved. The header courses may be backed with hollow brick.

Where floor beams rest on tile walls, 2 courses of hard burned brick shall be laid directly under such beams.

Where girders rest upon walls so that there is a concentrated load on the block of more than 1 ton, the blocks supporting the girder must be made solid by filling with Portland cement concrete. Where such concentrated loads shall exceed 3 tons, the blocks for 2 courses below and for a distance extending at least 18 inches each side of such girder, shall be made solid. Where the load on the wall exceeds 5 tons, the blocks for 3 courses beneath and at least 3 feet each side of such girder shall be made solid in a similar manner.

All piers or jambs that support loads in excess of 4 tons shall be built with brick masonry, concrete or blocks filled solid with Portland cement concrete.

Each tier of beams shall be anchored to the side and end walls at intervals of not more than 6 feet.

No walls constructed of hollow tile shall be broken to receive pipes, but must be provided with chase or especially moulded blocks.

Hollow blocks spanning more than 4 feet must be properly reinforced. The skew-backs must also be filled solid with concrete.

Where walls are decreased in thickness, the top course of the thicker wall must be made solid with concrete or have 2 courses of hard burned brick.

CHIMNEYS

No chimney shall be started or built upon any floor or wood beams. The bricks used in chimneys shall be good, hard, and well burned.

CORRIDOR WALLS AND FLOORS

Interior corridor walls and hallway floor construction must be of fireproof material. (See heater rooms, ceiling construction, for floor in corridors.)

HEIGHT OF CEILINGS

All ceilings shall be at least 12 feet in height. Every school building more than one story in height shall have sheet metal ceilings, or plastered ceilings on metal lath.

MANUAL TRAINING ROOMS

Any school building having rooms in the basement which are used for such activities as manual training, domestic science or chemical laboratory, said rooms shall have enclosing walls of fireproof construction. The ceilings over said rooms shall also be of fireproof materials. (See heater rooms, ceiling construction.) The interior doors leading to the rooms shall be of kalamein or other approved fireproof doors; said doors to be equipped with proper springs to keep them normally closed. No stops, hooks or other devices to hold the doors open will be approved. When such doors are glazed it must be with wire-glass.

STAIRS

Width, Treads, Risers

All stairways (except cellar stairs) must be not less than 4 feet in width and shall have intermediate landings. The stair risers shall not exceed 7 inches in height, and the treads shall not be less than 12 inches in width (including the projecting nosings).

A uniform width must be maintained in all stairways and platforms, and there must be a uniform rise and tread for each run.

HANDRAILS

Handrails shall be properly placed on both sides on all stairways used by pupils, and the inside rail must be continuous.

WINDERS

No winders will be allowed.

SAFETY TREADS

Stairways constructed of reinforced concrete shall have an approved non-slippable tread embedded in the concrete.

CONSTRUCTION, ENCLOSURE

All stairs must be constructed of fireproof material (except stairs in one-story buildings leading to the cellar or basement, which may be of slow-burning construction), with no open riser, and must be enclosed by fireproof walls and without open well holes.

PARTITIONS

All stairways in buildings of more than one story in height must be separated from corridors by thick wood, iron or kalamein partitions. Doors shall swing toward the exits only and be glazed with polished wire-glass. All such doors shall have door springs and checks, but no floor stops or other devices to hold the doors open will be allowed.

NUMBER OF STAIRWAYS

There should be 2 flights of stairs in buildings having more than two rooms and less than nine rooms on the second floor, 1 stairway at each end of the building, and each leading direct to an exit from the first floor to the ground.

Every school building having nine or more classrooms on the second floor shall have at least 3 flights of stairs, each leading to an exit from the first floor to the ground. There should be 1 stairway near each end of the building; other stairways must be subject to approval as to number and location in each case.

DOORS

"In any schoolhouse of two or more stories in height, the doors leading from the classrooms to the corridors, and from the said corridors to the street or to the ground surrounding such schoolhouse, shall open outward. All swing doors shall have plate glass windows of suitable dimensions." (Swing doors are construed to mean single and double acting doors.)

ANTI-PANIC BOLTS

All outside entrance or exit doors shall have key locks that can be locked on the outside only, but that can always be easily opened on the inside by simply turning the knob or pressing the release bar. No night-latch attachment, bolts, hooks, thumb knobs or other locking device is to be used.

FIRE DOOR AT BASEMENT STAIRWAY

Every school building shall have an exit to the ground for every flight of stairs leading to the first floor. All doors leading to the cellar or basement shall be fireproof and fitted with springs to keep them closed, except in one-story buildings.

CLOAK-ROOMS

Ample cloak-rooms shall be provided. They should be well lighted, ventilated and heated. They should be provided with a sufficient number of hooks so that each pupil may have one for his individual use. These hooks should be placed low enough so that the young children can readily reach them.

INSIDE TOILETS

Individual porcelain bowl water-closets, and slate, corrugated glass or porcelain urinals, properly ventilated, must be provided where running water can be secured. No latrine, range or incinerating closets will be permitted. All floor surrounding and within 3 feet of inside water-closets or urinals must be constructed of non-absorbent waterproof materials. Suitable wash-bowls must be installed in each toilet room.

VENT FLUES

The ventilating flues and ducts leading from toilet rooms must not connect with those leading to or from any other room. All toilet rooms must be located so as to receive ample outside light.

OUTSIDE DRY TOILETS

Each board of education shall provide at least two suitable and convenient outhouses or water-closets for each of the schoolhouses under its control. Said outhouses or water-closets shall be entirely separated each from the other, and shall have separate means of access. Said outhouses and said water-closets, if detached from the schoolhouse, shall be separated by a substantial close fence, not less than seven feet in height.

The vaults under these outhouses or water-closets shall be built of brick and laid in cement mortar or concrete and shall not extend under the floor of said buildings, but may project beyond the rear of the buildings to facilitate the proper cleaning.

The vaults shall be properly ventilated by running a wooden or metal flue from the underside of the floor line up through the roof. This flue should not be less than 8 inches square (inside measurement). Each toilet should be provided with a sash not less than 2 feet square, arranged to slide or hang on hinges. This opening must be covered with a close mesh copper wire fly screen. Outside of each boys' outhouse or water-closet, properly protected from the rain or snow, shall be provided a metal urinal trough drained into the vault of said closet. This trough and the buildings are to be properly screened by a tight board screen not less than 7 feet high. All outside toilet doors shall be equipped with proper locks and spring hinges or springs to keep said doors shut.

FIRE ESCAPES

Where fire escapes are found necessary they shall be constructed of iron strings, treads and closed risers, said risers being not more than 7 inches high and the treads not less than 10½ inches in width. The top platform must be level with the class-

room floor, and entrance to the platform shall be made by means of a door, which must be cut down to the level of the floor. The stairs shall not be less than 36 inches wide and shall be supported on strong iron brackets bolted entirely through the wall, or on iron columns. Long runs must have intermediate landings. The lowest flight must not be movable. The outside strings shall be protected by a heavy galvanized wire mesh screen or other approved protective railing not less than 5 feet high. Whenever a fire escape crosses a window, said window must be glazed with wire-glass. Hand-rails must be provided for each side of the stairs.

WASTE PAPER CHUTES

Waste paper chutes must be constructed of fireproof material throughout, including self-closing doors.

SEATING

All plans and blue prints must show the location of each pupil's and teacher's desk, together with the number of pupils' desks.

LIVING APARTMENTS

Living apartments will not be approved in any part of a school building.

APPLICATION FOR APPROVAL OF PLANS

The following form should be properly filled out and forwarded to the Secretary of the State Board of Education, with the plans and specifications submitted for approval. This blank may be obtained from the Commissioner of Education or the form may be copied from this pamphlet.

Date..

CALVIN N. KENDALL
Secretary State Board of Education, Trenton, N. J.
Dear Sir:

Herewith I submit for examination and approval the plans and specifications in duplicate for the proposed..

(New school house or addition)

to be known as

Name of school..

Street location ....

School District of..County of..

No. of sheets of building blue prints...

No. of sheets of heating and ventilation blue prints...

No. of rooms.. { with / without } Basement
(Cross out one)

brick or frame...

{ with / without } Auditorium
(Cross out one)

Money available $...........................Estimated cost of building $...........................

H. and V. $...........................Seating $...........................Total $...........................

Architect's name ....

Address ....

The District Clerk is..

Address ....

In drawing these plans and specifications I have fully complied with all the requirements of the New Jersey School Law in reference to school buildings.

....

(Signature)

THE NEW YORK LAW

No schoolhouse shall hereafter be erected in any city of the third class or any incorporated village or school district, and no addition to a school building in any such place shall hereafter be erected, the cost of which shall exceed five hundred dollars, until the plans and specifications for the same shall have been submitted to the commissioner of education and his approval indorsed thereon. Such plans and specifications shall show in detail the ventilation, heating and lighting of such building.

Such commissioner of education shall not approve any plans for the erection of any school building, or addition thereto, unless the same shall provide at least fifteen square feet of floor space and two hundred cubic feet of air space for each pupil to be accommodated in each study or recitation room therein, and no such plans shall be approved by him unless provision is made therein, for assuring at least thirty cubic feet of pure air every minute per pupil, and the facilities for exhausting the foul or

vitiated air therein shall be positive and independent of atmospheric changes.

No tax voted by a district meeting or other competent authority in any such city, village or school district exceeding the sum of five hundred dollars, shall be levied by the trustees until the commissioner of education shall certify that the plans and specifications for the same comply with the provisions of this section.

All schoolhouses for which plans and detailed statements shall be filed and approved, as required by this section, shall have all halls, doors, stairways, seats, passageways and aisles, and all lighting and heating appliances and apparatus, arranged to facilitate egress in cases of fire or accident and to afford the requisite and proper accommodations for public protection in such cases. All exit doors shall open outwardly, and shall, if double doors be used, be fastened with movable bolts operated simultaneously by one handle from the inner face of the door. No staircase shall be constructed with wider steps in lieu of a platform, but shall be constructed with straight runs, changes in direction being made by platforms. No doors shall run immediately upon a flight of stairs, but a landing at least the width of the door shall be provided between such stairs and such doorways.

This act shall take effect immediately.

The following points should be specially observed:

1. The plans and specifications must be submitted in duplicate, the original set to be returned after the indorsement of approval. the duplicate to be retained on file at this department.

2. The plans and specifications must show in detail the ventilation, heating and lighting of the building and must be accompanied by a guaranty from the contractor that the system of ventilation described will provide at least 30 cubic feet of air every minute for each pupil. It will be necessary to give the size of windows, distance from top of window to ceiling and number of panes in sash.

3. At least 15 square feet of floor space and 200 cubic feet of air space for each pupil to be accommodated in each study or recitation room must be provided. In this connection it will be necessary not only to state the size of the rooms (length, breadth and height) but also to give the number of individual desks to be placed in the room.

The plans and specifications must clearly show that proper provision is made in all respects "to facilitate egress in cases of fire or accident and to afford requisite and proper accommodations for public protection in such cases."

NORTH DAKOTA LAW

GOVERNING THE CONSTRUCTION OF PUBLIC SCHOOL BUILDINGS AND PROVIDING FOR THE INSPECTION VENTILATION AND SANITATION THEREOF

An Act entitled "An Act for the Purpose of Governing the Construction of Public School Buildings and Providing for the Inspection, Ventilation and Sanitation Thereof."

Be it Enacted by the Legislative Assembly of the State of North Dakota:

BUILDINGS INSPECTED

1. *Plans and specifications to be submitted to superintendent of public instruction.*—No building which is designed to be used, in whole or in part, as a public school building, shall be erected until a copy of the plans thereof has been submitted to the state superintendent of public instruction, who for the purposes of carrying out the provisions of this act is hereby designated as inspector of said public school building plans and specifications, by the person causing its erection or by the architect thereof; such plans shall include the method of ventilation provided for, and a copy of the specifications therefor.

CONSTRUCTION OF SCHOOL HOUSES

2. Such plans and specifications shall show in detail the ventilation, heating and lighting of such building. The state

superintendent of public instruction shall not approve any plans for the erection of any school building or addition thereto unless the same shall provide at least twelve square feet of floor space and two hundred cubic feet of air space for each pupil to be accommodated in each study or recitation room therein.

(1.) Light shall be admitted from the left or from the left and rear of class rooms and the total light area must, unless strengthened by the use of reflecting lenses be equal to at least 20 per cent of the floor space.

(2.) All ceilings shall be at least twelve feet n height.

(3.) No such plans shall be approved by him unless provision is made therein for assuring at least 30 cubic feet of pure air every minute per pupil and warmed to maintain an average temperature of 70 degrees F. during the coldest winter weather, and the facilities for exhausting the foul or vitiated air therein shall be positive and independent of atmospheric changes. No tax voted by a district meeting or other competent authority in any such city, village, or school district, exceeding the sum of two thousand dollars ($2000.00) shall be levied by the trustees until the state superintendent of public instruction shall certify that the plans and specifications for the same comply with the provisions of this act. All school houses for which plans and detailed specifications shall be filed and approved, as required by this act, shall have all halls, doors, stairways, seats, passageways and aisles and all lighting and heating appliances and apparatus arranged to facilitate egress in case of fire or accident and to afford the requisite and proper accommodations for public protection in such cases. All exit doors shall open outwardly, and shall if double doors be used, fasten with movable bolts operated simultaneously by one handle from the inner face of the door. No staircase shall be constructed with wider steps in lieu of a platform, but shall be constructed with straight runs, changes in direction being made by platform. No doors shall open immediately upon a flight of stairs, but a landing at least the width of the door shall be provided between such stairs and such doorway.

(4.) Every public school building shall be kept clean and free from effluvia arising from any drain, privy or nuisance, and shall be provided with sufficient number of proper water closets, earth closets or privies, and shall be ventilated in such a manner that the air shall not become so impure as to be injurious to health.

TOILET ROOMS

3. *How Constructed.*—No toilet rooms shall be constructed in any public school building unless same has outside ventilation and windows permitting free access of air and light. The provisions of this act shall be enforced by the state superintendent of public instruction or some person designated by him for that purpose.

METHOD OF INSPECTION AND ADJUSTMENT OF GRIEVANCES

4. If it appears to the state superintendent of public instruction or his deputy appointed for that particular purpose, that further or different sanitary or ventilating provisions, which can be provided without unreasonable expense, are required in any public school building, he may issue a written order to the proper person or authority, directing such sanitary or ventilating provisions to be provided. A school committee, public officer or person who has charge of any such public school building, who neglects for four weeks to comply with the order of said state superintendent of public instruction or his deputy, shall be punished by a fine of not less than one hundred dollars nor more than one thousand dollars.

(1.) Whoever is aggrieved by the order of the state superintendent of public instruction or his deputy issued as above provided, and relating to a public school building, may within thirty days after the service thereof, apply in writing to the board of health of the city, town, incorporated village or school board, after notice to all parties interested, shall give a hearing upon such order, and may alter, annul or affirm it.

VENTILATING FLUES AND METHOD OF CONSTRUCTING SAME

5. No wooden flue or air duct for heating or ventilating purposes shall be placed in any building which is subject to the provisions of this act, and no pipe for conveying hot air or steam in such building shall be placed or remain within one inch of any woodwork, unless protected by suitable guards or casings of incombustible material.

APPROVAL OF PLANS

6. *By Whom and Penalty for Violation.*—To secure the approval of plans showing the method or systems of heating and ventilation as provided for in section 2 the foregoing requirements must be guaranteed in the specifications accompanying the plans. Hereafter erections or constructions of public school buildings by an architect or other person who draws plans or specifications or superintends the erection of a public school building, in violation of the provisions of this act, shall be punished by a fine of not less than one hundred dollars nor more than one thousand dollars.

THE OHIO CODE

TITLE 3—SCHOOL BUILDINGS

CLASSIFICATION

SECTION 1. Under the classification of "School Buildings" are included all public, parochial and private schools, colleges, academies, seminaries, libraries, museums and art galleries, including all buildings or structures containing one or more rooms used for the assembling of persons for the purpose of acquiring knowledge, or for mental training.

Grade A.—Under this grade are included all rooms or buildings appropriated to the use of primary, grammar or high schools, including all rooms or buildings used for school purposes by pupils or students eighteen (18) years of age or less.

Grade B.—Under this grade are included all rooms or buildings appropriated to the use of schools, colleges, academies,

seminaries, libraries, museums, and art galleries; including all rooms or buildings not included under grade "A."

CLASS OF CONSTRUCTION

SECTION 2. *Grade A.*—No building of this grade shall have the topmost floor level more than thirty-eight (38) feet above the average grade of the building.

Buildings with the topmost floor level from twenty-three (23) to thirty-eight (38) feet above the average grade shall be of fireproof construction.

Buildings with the topmost floor level less than twenty-three (23) feet above the average grade shall be of fireproof or composite construction.

No building of this grade shall have the first floor level less than four (4) feet above the average grade.

Grade B.—No building of this grade shall have the topmost floor level more than fifty (50) feet above the average grade line.

Buildings with the topmost floor level from thirty (30) to fifty (50) feet above the average grade shall be of fireproof or composite construction.

Buildings with the topmost floor level less than thirty (30) feet above the average grade shall be of fireproof or composite construction.

Grades A and B—Buildings one story high, without basement and with the floor line not more than four (4) feet nor less than two (2) feet above the grade shall be of fireproof, composite or frame construction, providing when built of frame construction the same is erected thirty (30) feet away from any other building structure or lot lines.

EXPOSURE AND COURTS

SECTION 3. *Exposure.*—A building of A grade shall be erected upon a lot or site of such dimensions as will provide for each pupil not less than thirty (30) square feet of playground space; or, all or part of such playground space may be within or on top of the school building.

No building of grade B shall occupy more than ninety-five (95) per cent of a corner lot nor more than ninety (90) per cent of an interior lot or site. The measurements being taken at the lowest tier of floor joists.

No wall of any building of this classification containing windows used for lighting school or class rooms shall be placed nearer any opposite building, structure or property line than thirty (30) feet.

Courts—Recess or inner courts may be used providing the least distance between any two opposite walls containing windows used for lighting class and school rooms is equal to the height from the lowest window sill to the top of the highest cornice or fire wall. All walls to inner or recess courts shall be of masonry or other fireproof construction (except for buildings of frame construction).

If areas are used for lighting basements, the width of the area shall be not less than equal to the height from the lowest window sill to the top of the adjoining grade.

SUB-DIVISIONS AND FIRE STOPS

SECTION 4. Buildings of this classification built in connection or as part of a building of a lower grade of construction, shall be separated from the other parts of the building by standard fire walls, and all communicating openings in these walls shall be covered by double standard fire doors, using a standard self-closing door on one side of the wall and either a standard automatic fire door or a standard automatic rolling steel door on the other side of the wall.

All rooms or apartments used for general storage, storing of furniture, carpenter shops, general repairing, paint shops or other equally hazardous purposes shall be constructed with standard fireproof walls, ceilings and floors, and all openings between these rooms or apartments and the other parts of the building shall be covered by double fire doors, using a standard self-closing door on one side of the wall and a standard automatic fire door or standard automatic rolling steel door on the other side of the wall.

No open wells communicating between any two (2) stories of a public hall shall be used, in a building of A or B grade of composite construction; nor, in a building of A grade of fireproof construction, except the necessary stair and elevator wells.

In B grade buildings of fireproof construction open wells communicating between stories may be used in connection with monumental stairways and rotundas, when at least one means of egress is provided for each wing or section of each building, and such means of egress is located at the opposite end of such wing or section from the open well.

All external and court walls of buildings under this classification (except buildings of frame construction) within thirty (30) feet of any other building structure or lot line shall be provided with the following fire stops, viz.:

Walls shall be standard fire walls.

All windows shall be automatic standard fireproof windows, and all door openings shall be covered by standard hinged fire doors without automatic attachment.

HEATER ROOM

SECTION 5. Furnaces, hot water heating boilers and low pressure steam boilers may be located in the buildings, providing the heating apparatus, breeching, fuel room and firing room are inclosed in a standard fireproof heater room, and all openings into the same from the other parts of the building are covered by standard self-closing fire doors.

No boiler or furnace shall be located under any lobby, exit, stairway or public hall.

No cast iron boiler operated at more than ten (10) pounds pressure or steel boiler operated at more than thirty-five (35) pounds pressure shall be located within the main walls of any school building.

BASEMENT ROOMS

SECTION 6. No room used for school purposes shall be placed wholly or partly below the grade. Rooms for domestic science, manual training and recreation may be placed partly

below the grade, provided the same are properly lighted, heated and ventilated.

If areas are used the width of the area shall not be less than equal to the height from the lowest window sill to the grade.

DIMENSIONS OF SCHOOL AND CLASS ROOM

SECTION 7. *Floor Space.*—The minimum floor space to be allowed per person in school and class rooms, shall not be less than the following, viz.:

Primary grades sixteen (16) square feet per person.

Grammar grades eighteen (18) square feet per person.

High schools twenty (20) square feet per person.

All other schools and class rooms twenty-four (24) square feet per person.

Cubical Contents.—The gross cubical contents of each school and class room, shall be of such a size as to provide for each pupil or person not less than the following cubic feet of air space, viz.:

Primary grades 200 cubic feet.

Grammer grades 225 cubic feet.

High schools, 250 cubic feet and in grade B buildings 300 cubic feet.

Height of Stories.—Toilet, play, rest and recreation rooms shall be not less than eight (8) feet high in the clear measuring from the floor to the ceiling line.

The height of all rooms, except toilet, play, rest and recreation rooms shall be not less than one-half the average width of the room, and in no case less than ten (10) feet high.

REST ROOMS

SECTION 8. In all school buildings of grade "A" containing four and not more than eight (8) school or class rooms, a rest or hospital room shall be provided, and in all school buildings of grade "A" containing more than eight school or class rooms, two such rooms shall be provided.

Where a water supply is available each rest room shall be provided with a water closet and sink.

ASSEMBLY HALLS

SECTION 9. A room seating or accommodating more than one hundred (100) persons shall be considered as an assembly hall.

Assembly halls used in connection with and as a necessary adjunct to a school building and not rented or let out for the use of the general public are classified as minor assembly halls and shall be designed, constructed and equipped as prescribed for clubs and lodge buildings (see Part 2, Title 6), except no minor assembly hall in an "A" grade school building of fireproof construction shall be placed more than twenty-three (23) feet; nor in a building of composite construction more than ten (10) feet above the grade at any entrance to or exit from the same; nor shall such a minor assembly hall for an "A" grade school be placed in a building of frame construction and not more than one balcony shall be placed in an auditorium of composite construction.

SEATS, DESKS AND AISLES

SECTION 10. *Securing seats.*—Seats, chairs and desks placed in class, recitation, study and high school rooms shall be securely fastened to the floor, except in rooms seating less than fifteen (15) persons, and where the nature of the occupancy will not permit.

Desks and chairs used by the teachers may be portable.

Class room seats and aisles.—Class and school rooms shall have aisles on all wall sides.

In primary rooms, center aisles shall not be less than one foot five inches (1′ 5″) and wall aisles not less than two feet four inches (2′ 4″) wide.

In Grammar rooms, center aisles shall not be less than one foot six inches (1′ 6″) and wall aisles not less than two feet six inches (2′ 6″) wide.

In high school rooms, center aisles shall not be less than one foot eight inches (1′ 8″) and wall aisles not less than three (3) feet wide.

In all other class and school rooms, center aisles shall not be less than two (2) feet and wall aisles not less than three (3) feet wide.

OPTICS

SECTION 11. The proportion of glass surface in museums, libraries and art galleries, shall not be less than one (1) square foot of glass to each six (6) square feet of floor area.

The proportion of glass surface in each class, study, recitation, high school rooms and laboratory, shall be not less than one (1) square foot of glass to each five (5) square feet of floor area. (For glass surface in rooms used for domestic science and manual training, see Part 2, Title 7, Section 10, Workshops, Factories and Mercantile Establishments.)

The proportion of glass surface in each play, toilet or recreation room, shall be not less than one (1) square foot of glass surface to each ten (10) square feet of floor area.

Windows shall be placed either at the left, or the left and rear of the pupils when seated.

Tops of windows, except in libraries, museums and art galleries shall not be placed more than eight (8) inches below the minimum ceiling height as established under "Dimensions of School and Class Rooms." (See Section 7.)

The unit of measurement for the width of a properly lighted room, when lighted from one side only, shall be the height of the window head above the floor.

The width of all class and recitation rooms when lighted from one side only, shall never exceed two and one-half (2½) times this unit measured at right angles to the source of light.

All windows shall be placed in the exterior walls of the building, except for public halls, corridors, stock and supply closets, which may be lighted by ventilated skylights or by windows placed in partitions or partition walls.

Museums, libraries and art galleries may be lighted by skylights, or clere story windows.

SECTION 12. All means of egress shall be exit doors unless the same lead to "A" standard fire escapes, which shall be either exit doors or exit windows.

Grade A. Buildings of Fire Proof Construction. Means of egress from rooms in the basement and superstructure shall be in proportion to three (3) feet in width to each one hundred (100) persons to be accommodated in buildings accommodating not more than five hundred (500) persons.

When buildings accommodate from five hundred (500) to one thousand (1,000) persons, two (2) feet additional exit width shall be provided for each one hundred (100) persons or fraction thereof in excess of five hundred (500) persons.

When buildings accommodate more than one thousand (1,000) persons one (1) foot additional exit width shall be provided for each one hundred (100) persons or fraction thereof in excess of one thousand (1,000) persons, but in no case shall an exit be less than three (3) feet or more than six (6) feet wide.

In computing the widths of exits at the foot of stairways the standing capacity of the stairway including the landings, allowing three (3) square feet per person may be deducted from the number of persons the exit shall be designed to accommodate.

Buildings of fireproof construction shall have at least two (2) stairways located as far apart as possible and the same shall be continuous from the grade to the topmost story.

The basement shall have at least two stairways located as far apart as possible and run from the basement floor level to the grade which stairway may be placed under the main stairway.

When buildings are divided into sections or parts by solid partitions or by partitions wth doors normally locked, each such section or part of the building shall have two (2) stairways as above prescribed.

No further means of egress will be necessary.

Grade B. Buildings of Composite Construction.—Each room in the superstructure used by pupils as a class or school

room shall have at least two separate and distinct means of egress.

No class, school or high school room shall have more than one door or opening between it and the main halls or corridors of the building.

Communicating doors between two class or school rooms shall not be considered as a means of egress, except school or class rooms accommodating not more than fifteen (15) pupils and directly connected with another school or class room provided with two (2) means of egress as above prescribed, may be considered as part of the adjoining class room and need not have any additional means of egress.

The width of the means of egress shall not be less than three (3) feet to each one hundred (100) persons to be accommodated.

One half of the means of egress shall lead to the public halls and the other half to inclosed fireproof stairways, B, C or D standard fire escapes or stone, cement or iron steps leading to the grade. No exit door shall be less than three (3) feet or more than six (6) feet wide. No fire escape or outside stairway shall be used when the height of the same exceeds eight (8) feet above the grade.

Each room in the basement used by the pupils shall have a direct exit not less than three (3) feet wide, with stone, cement or iron steps leading up to the grade.

Steps shall be not less than three feet six inches (3′ 6″) wide. Areas around such steps shall have substantial hand and guard rails on both sides.

These means of egress from the basement shall be provided in addition to the usual service stairways and means of ingress.

Grade B. Buildings of Fireproof or Composite Construction.—Each room or apartment used for any purposes other than storage shall have two separate and distinct means of egress.

If the various rooms connect directly with a public hall, means of egress at each end of the public hall will be sufficient.

These means of egress shall be either an inside stairway running continuously from the grade to the topmost story, or

from the basement to the grade; A, B, C or D standard fire-escapes; stone, cement or iron steps extending to the grades; or self-closing doors connecting directly with a public hall of an adjoining section of the same building containing a stairway.

Means of egress shall be at the ratio of three (3) feet per one hundred (100) persons accommodated in buildings accommodating not more than five hundred (500) persons, when building accommodates from five hundred (500) to one thousand (1,000) persons two (2) feet of additional stairway width shall be provided for every one hundred (100) persons or fraction thereof in excess of five hundred (500), when buildings accommodate more than one thousand (1,000) persons one foot additional stairway width shall be provided for every one hundred (100) persons or fraction thereof in excess of one thousand (1,000) persons.

In computing the width of exits at the foot of stairways the standing capacity of the stairway, including the landings, allowing three (3) square feet per person may be deducted from the number of persons the exit should be designed to accommodate.

It shall be presumed that the persons assembled will be equally distributed to the various means of egress.

In libraries, museums and art galleries the capacity of the building shall be established by allowing to each person fifty (50) square feet of floor area, except in stack rooms.

Grade A and B. Buildings of Frame Construction.—Each room shall have at least two three (3) foot exits; one leading to the open with steps to the grade, and the other the usual means of ingress; and all steps shall have hand rails on both sides.

Signs for all Buildings.—Over each exit door shall be painted a sign indicating the word "EXIT" in plain block letters not less than six (6) inches high.

STAIRWAYS

SECTION 13. *Grade A. Buildings of Fireproof Construction.*—For the number and location of stairways see "Means of Egress" (Section 12.)

The main service stairways shall be enclosed with walls or partitions made of incombustible material, or wire glass not less than one-quarter (¼) inch thick set in metal sash and frames, with standard self-closing fire doors at each story, and shall be provided with platforms and exit doors not less than three feet (3′) wide at the grade.

No wire glass shall be used in partitions separating stairways from rooms containing highly combustible materials.

Grade A. Buildings of Composite Construction.—Basement stairways shall be enclosed with either brick walls not less than nine (9) inches thick, concrete walls not less than six (6) inches thick, or hollow tile walls not less than twelve (12) inches thick.

All openings in these walls shall be provided with standard self-closing fire doors. The width of stairways required under this classification shall be equally divided, one-half being placed in the main service stairways and the other half in the standard enclosed fireproof stairs or fire escapes.

Grade B. Buildings of Fireproof Construction.—Stairways shall be separted from the other parts of the building by walls or partitions made of incombustible material, or wire glass not less than one-quarter (¼) inch thick set in metal sash and frames with standard self-closing fire doors.

No wire glass shall be placed in partitions separating stairways from rooms containing highly combustible material.

Stairways shall be provided with grade platforms with exit doors not less than three (3) feet wide leading to streets, alleys, yards, or courts.

Grade B. Buildings of Composite Construction.—In buildings of composite construction the stairways shall be separated from the other parts of the building by standard fireproof walls, standard fireproof ceilings at the topmost story, standard fireproof floors at the lowermost level, and all openings to these inclosures shall be provided with standard self-closing fire doors.

The above enclosure shall be provided with grade platforms, and with exit doors not less than three (3) feet wide leading to streets, alleys, yards or courts.

Stairway Construction.—Width of stairway shall be at the ratio of three (3) feet per one hundred (100) persons accommodated in buildings, accommodating not more than five hundred (500) persons, when building accommodates from five hundred (500) to one thousand (1,000) persons two (2) feet of additional stairway width shall be provided for every one hundred (100) persons or fraction thereof in excess of five hundred (500), when buildings accommodate more than one thousand (1,000) persons one (1) foot additional stairway width shall be provided for every one hundred (100) persons or fraction thereof in excess of one thousand (1,000) persons.

In computing the width of stairways the standing capacity of the stairway including the landings allowing three (3) square feet per person may be deducted from the number of persons the stairway should be designed to accommodate.

No stairway shall be less than three (3) feet six (6) inches nor more than six (6) feet wide measuring between the hand rails. Stairways over six (6) feet wide shall have substantial center hand rails with angle and newel posts not less than six (6) feet high. No stairway shall have less than three (3) nor more than sixteen (16) risers in any run.

No stairway shall have winders and all nosing shall be straight.

A uniform width shall be maintained in all stairways and stair platforms by rounding or beveling the corners and angles.

Hand rails shall be provided on both sides of all stairways and steps.

Outside steps and areas shall be provided with guard rails not less than two (2) feet six (6) inches high.

Stairways shall have a uniform rise and tread in each run as follows, viz.:

Primary schools shall have not more than a six (6) inch rise nor less than eleven (11) inch tread.

Grammar schools shall have not more than a six and one-half (6½) inch rise nor less than eleven (11) inch tread.

All other schools shall have not more than a seven (7) inch rise nor less than ten and one-half (10½) inch tread.

The above dimensions shall be from tread to tread, and from riser to riser.

No door shall open directly upon a stairway, but shall open on a platform or landing equal in length to the width of the door.

In combination primary and grammar school buildings all stairways below the first floor shall be designed for primary school pupils, and all stairways above the first floor may be designed for either primary or grammar pupils.

No closet for storage shall be placed under any stairway.

All treads shall be covered with rubber or lead mats, securely fastened to place or be formed with non-slipping surfaces.

Monumental Stairways and Steps.—Monumental stairways may be used in grade "B" buildings when such buildings are provided with stairways as prescribed under Sub-divisions and Fire Stops (see Section 4).

Monumental stairways may be of a greater width than six (6) feet measuring between the hand rails, and such stairways need not be provided with more hand rails than would be necessary for the actual width required as a means of egress.

Monumental steps from the grade to the first story with more than five (5) risers, shall be provided with hand rails on both sides of the same, and such steps with five (5) or less risers need not be provided with hand rails.

GRADIENTS

SECTION 14. To overcome any difference in floor levels which would require less than three (3) risers, gradients shall be employed of not to exceed one (1) foot rise in twelve (12) feet of run.

PASSAGEWAYS

SECTION 15. No public hall leading to a stairway or exit shall be less in width than the stairway or exit, as the case may be.

Public halls and passageways shall be so designed and proportioned as to prevent congestion and confusion.

ELEVATORS

SECTION 16. Elevators shall not be considered or computed as a means of egress. (For the construction of elevators and elevator shafts see Elevators, Part 8.)

EXIT DOORS AND WINDOWS

SECTION 17. Doors to rooms occupied by less than ten (10) persons are not considered under the classification of exit doors.

Exit doors shall not be less than three (3) feet wide, not less than six (6) feet four (4) inches high, level with the floor, swing outward, viz.: toward the opening, or toward the natural means of egress, and shall be so hung as not to interfere with passageways or close openings, stairways or fire escapes.

No single door or leaf to a double door shall be more than four (4) feet wide. No two (2) doors hinged together shall be used as a means of ingress or egress. Accordion doors may be used in dividing class rooms, providing the free sections swing outward and provide the required amount of exit width.

No double acting, rolling, sliding or revolving doors shall be installed where used or liable to be used as a means of ingress or egress except as previously prescribed under sub-divisions (see Section 4).

Sliding or rolling doors may be used when installed in addition to the prescribed means of egress.

(For exit windows see Standard Devices, Part 3, Title 7, Section 6.)

SCUTTLES

SECTION 18. Every building exceeding twenty-five (25) feet in height shall have in the roof a bulk-head or scuttle not less than two (2) feet wide and not less than three (3) feet long, covered on the outside with metal and provided with a stairway or permanent ladder leading thereto.

Bulk-head and scuttle doors shall not be provided with locks.

SPECIAL CONSTRUCTION

SECTION 19. All floors to toilet rooms, lavatories, water closet compartments, or any enclosure where plumbing fixtures are used within the building shall have a waterproof floor and base as prescribed under Sanitation (see Part 4, Title 12, Section 1).

All basement rooms used by the pupils or public shall have a damp-proof or water-proof floor properly drained to carry off surface water.

All basement ceilings except where concrete or brick is used shall be plastered or be covered with pressed or rolled steel ceiling.

Whenever possible, window and door jambs shall be rounded and plastered, except in museums, libraries and art galleries.

All interior wood finish shall be as small as possible and free from unnecessary dust catchers.

All floors between the finished portions of the building shall be deadened or made sound-proof.

FLOORS AND ROOF LOADS

SECTION 20. In calculating construction the superimposed load uniformly distributed on the various floors and roofs shall be assumed at not less than the following, viz.:

Class-rooms, sixty (60) pounds per square foot.

Public halls, assembly halls, and stairways, eighty (80) pounds per square foot.

Museums, libraries and art galleries, one hundred (100) pounds per square foot.

Attics not used for storage, twenty (20) pounds per square foot.

Roofs, forty (40) pounds per square foot.

HEATING AND VENTILATING

SECTION 21. A heating system shall be installed which will uniformly heat all public halls, play rooms, toilet rooms, recreation rooms, assembly rooms, gymnasiums and manual training rooms to a uniform temperature of 65 degrees in zero weather; and will uniformly heat all other parts of the building to 70 degrees in zero weather.

Exceptions.—Rooms with one or more open sides used for open-air or outdoor treatment.

A combination heating and ventilating system shall be installed which will at normal temperature supply the following amounts of fresh air, viz.: In all parts of "A" grade building except corridors, hall and storage closets, six (6) changes of air per hour; in all parts of colleges, academies and seminaries except corridors, halls and storage closets, supply to each person the room is designed to accommodate, eighteen hundred (1,800) cubic feet of air per hour—in which case the plans shall be clearly marked showing the maximum number of persons the room will accommodate, libraries, museums and art galleries need not be provided with a change of air.

The heating system to be installed where a change of air is required, shall be either standard ventilating stoves, gravity or mechanical furnaces, gravity indirect steam or hot water, a mechanical indirect steam or hot water system or a split steam or hot water system.

Where wardrobes are not separated from the class-room they shall be considered as part of the class-room and the vent register shall be placed in the wardrobe.

Where wardrobes are separated from the class-room, they shall be separately heated and ventilated the same as the class-

rooms, and shall be provided with not less than six (6) changes of air per hour.

No floor registers shall be used in any part of the building, except foot warmers which may be placed in the floors of the main corridors or lobbies.

A hood shall be placed over each and every stove in the domestic science room, over each and every compartment desk or demonstration table in the chemical laboratories and chemical laboratory lecture rooms, of such a size as to receive and carry off all offensive odors, fumes and gases.

These ducts shall be connected to vertical ventilating flues placed in the walls and shall be independent of the room ventilation as previously provided for.

Where electric current is available electric exhaust fans shall be placed in the ducts or flues from the stove fixtures in domestic science rooms and chemical laboratories, and where electric current is not available and a steam or hot-water system is used, the main vertical flues from the above ducts shall be provided with accelerating coils of proper size to create sufficient draught to carry away all fumes and offensive odors.

SANITATION

SECTION 22. Where a water supply and sewerage system are available a sanitary equipment shall be installed as follows:

Drinking fountains shall be provided as follows, viz.: In grade "A" school buildings one in each story of the superstructure to each six thousand (6,000) square feet of floor area or less; and, one in the basement to each two hundred (200) males or less and one to each two hundred (200) females or less.

In all other buildings one drinking fountain shall be provided to each six thousand (6,000) square feet of floor area or less. These shall be centrally located and if more than one is required they shall be located in different stories of the building.

Drinking fountains shall have a jet giving a continuous flow of water or be operated by a ring or foot valve.

"A" grade school buildings shall be provided with slop sinks in the number as prescribed for drinking fountains, or in lieu of slop sinks lavatories without stoppers may be used.

In colleges, academies and seminaries one lavatory without stopper shall be provided to each one hundred (100) persons.

In libraries, museums and art galleries there shall be provided the following fixtures, viz.:

One water-closet to each fifty (50) females or fraction thereof.

One water-closet to each one hundred (100) males or fraction thereof.

One urinal to each one hundred (100) males or fraction thereof.

The above to be based upon the actual number of persons to be accommodated, the capacity being established as prescribed under means of egress (Section 12).

In all other school buildings there shall be provided the following fixtures, viz.:

One water-closet for each fifteen (15) females or fraction thereof.

One water-closet for each twenty-five (25) males or fraction thereof.

One urinal for each fifteen males or fraction thereof.

Toilet accommodations for males and females shall be placed in separate rooms, with a traveling distance between the same of not less than twenty (20) feet.

Juvenile or short closets shall be used for primary and grammar grade schools. This does not apply when latrine closets are used.

In buildings accommodating males and females it shall be presumed that the occupants will be equally divided between males and females, unless such building be used exclusively by either sex or a different constant proportion is known.

Where water supply and sewerage systems are not available no sanitary equipment shall be installed within the building, but pumps in lieu of drinking fountains, closets and urinals in

the above proportions shall be placed upon the school building grounds, and no closets or urinals shall be placed nearer any occupied building than fifty (50) feet.

Buildings more than three (3) stories in height shall be provided with toilet rooms in each story and basement, and in these shall be installed water-closets and urinals in the above prescribed ratios in proportion to the number of persons to be accommodated in the various stories.

Toilet rooms for males shall be clearly marked "BOYS' TOILET" or "MEN'S TOILET" and for females "GIRLS' TOILET" or "WOMEN'S TOILET."

GAS AND VAPOR LIGHTING

SECTION 23. A system of gas or vapor lighting, if used, shall be installed as follows:

All outlets in class and recitation rooms shall be dropped from the ceiling and be equally distributed so as to uniformly light the room.

The number of burners provided shall not be less than the following:

In gymnasiums one three (3) foot burner to each fifteen (15) square feet of floor area.

In public halls and stairways one three (3) foot burner to each twenty-four (24) square feet of floor area.

In class and recitation rooms one three (3) foot burner to each twelve (12) square feet of floor area.

Enclosed fire-proof stairways, service stairways, public halls, and toilet rooms, shall be lighted by artificial light, and the same shall be provided with a sufficient number of outlets, properly located to amply light the same at night.

Burners shall be placed seven (7) feet above the floor line.

If gas or vapor lighting is used the same shall be installed as prescribed under Gas, Vapor and Oil Fitting and Equipment (see Part 6).

ELECTRICAL WORK

SECTION 24. An electric lighting system, if used, shall be installed as follows:

All wiring shall be done in conduit or armored cable and the same shall be installed as prescribed under Electrical Work (see Part 7).

All outlets in class and recitation rooms shall be dropped from the ceiling and be equally distributed so as to uniformly light the room.

The candle-power of lamps provided shall not be less than the following, viz.:

Gymnasium one candle-power to two and one-half square feet of floor area.

Public halls and stairways one candle-power to four square feet of floor area.

Class and recitation rooms one candle-power to two square feet of floor area.

Enclosed fire-proof stairways, service stairways, public halls and toilet rooms shall be lighted by artificial light and the same shall be provided with a sufficient number of lights, properly located to amply light the same at night.

FINISHING HARDWARE

SECTION 25. All entrance and exit doors shall be equipped with hardware of such a nature as to be always unlockable from within.

Single outside doors used for egress only shall have one knob latches or double extension bolts as hereinafter prescribed and no bolts, hooks or other locking device shall be placed on these doors.

Single outside doors used for ingress and egress, shall have locks that may be locked from the outside only, but can always be opened on the inside, by simply turning the knob or lever, or by pushing against a bar or plate.

No attachment shall be placed on these locks, which will interfere with their free and immediate operation at all times, and no bolts, hooks, thumb latches or other locking devices shall be used.

Doors from public halls to rooms and cloak rooms shall have no locks upon same, but shall be equipped with knob latches

only. If locks are desired the same style locks as above prescribed for entrance doors shall be used and they shall be so placed on the door that they can be locked on the hall side, and can always be opened on the room or cloak room sides, whether locked on hall side or not.

One of each pair of double doors shall be equipped with a double extension bolt on one door operated by a knob, lever, push bar, push plate, push handle, or device whereby the simple act of turning a knob, or lever, or pushing against the same will release the top and bottom bolts at the same time.

Independent top and bottom bolts shall not be used.

All bolts, latches, face of locks, working parts of extension bolts, and other exposed working parts about this hardware shall be of cast metal properly protected from corrosion.

(For hardware for exit windows see Standard Devices, Part 3, Title 7, Section 6.)

FIRE EXTINGUISHERS

SECTION 26. Where a water supply of sufficient pressure to reach the various portions of the building is available standard stand pipe and hose shall be provided in the basement of grade "A" buildings and in each story and basement of grade "B" buildings with sufficient length of one and one-half ($1\frac{1}{2}$) inch hose to reach any part of the story.

Hose lengths shall be not more than seventy-five (75) feet long, and where hose of such length will not reach the extreme portions of the story additional stand pipes and hose shall be provided.

NOTE: All rooms or apartments used for storing of furniture, carpenter shops, general repairing, paint shops or other equally hazardous purposes shall be provided with standard automatic sprinklers.

Where water supply of sufficient pressure to reach the extreme portions of the building is not available, standard chemical fire extinguishers shall be provided in the proportion of one (1) extinguisher to each two thousand (2,000) square feet of floor area or less.

Standard chemical fire extinguishers shall be provided in each story above the basement of all grade "A" buildings in the proportion of one (1) extinguisher to each two thousand (2,000) square feet of floor area, or less.

All stand pipes and hose shall be prominently exposed to view and always accessible.

FIRE ALARM

SECTION 27. All buildings with basement, and all buildings more than one story high shall be provided with eight (8) inch in diameter trip fire gong with connections enabling the ringing of same from any story or basement.

In semi-detached buildings gongs shall be provided for each section and shall be connected up so as to ring simultaneous from any story or basement of either section.

Gongs shall be centrally located in the public halls, and the operating cords shall be placed so as to be always accessible.

Exceptions.—In institutions for the deaf, electric lights with red globes shall be placed near each teacher's desk, and these shall be operated simultaneously by switches placed in each story and basement.

BLOWERS IN WORKSHOPS

SECTION 28. See Maintenance of Buildings (Part 11, Title 1, Section 40).

GUARDING MACHINERY AND PITS

SECTION 29. See Maintenance of Buildings (Part 11, Title 1, Section 40).

Note: The entire Ohio building code may be had upon request of The State Inspector of Workshops and Factories. Only such portions are here printed as directly relate to school buildings.

PART II—TITLE I

THEATERS AND ASSEMBLY HALLS

CLASSIFICATION

SECTION 1. *Theaters.*—Under the classification "Theaters" are included all buildings or parts of buildings in which persons congregate to witness spectacular, vaudeville, burlesque, dramatic or operatic performances, or other buildings or parts of buildings in which movable scenery is used, or in which motion pictures are thrown upon canvas, screens or walls.

This classification shall not apply to nor include buildings or parts of buildings designed and used for a different kind of occupancy than a theater, when such motion picture machine is used not to exceed seven (7) days in any one month; nor, does it include buildings or parts of buildings included under the classification of Club and Lodge Buildings or Minor Assembly Halls, when such picture machine is used to illustrate educational or ritualistic work and the general public is not admitted thereto.

Assembly Halls.—Under the classification of "Assembly Halls" are included all buildings or parts of buildings in which persons are assembled for entertainment, amusement or dancing, including all buildings or parts of buildings in which persons congregate to witness vaudeville, burlesque, dramatic or operatic performances, to hear speakers or lectures, to listen to operas, concerts or musical entertainments in which no scenery is used and no motion pictures are thrown upon canvas, screens or walls (see exceptions under Sec. 1, Theaters), and, seating or accommodating one hundred (100) or more persons.

All assembly halls used in connection with and as a necessary adjunct to school buildings, hospitals, clubs or lodge buildings, hotels, workshops, factories or mercantile establishments or similar buildings or institutions and used for private gatherings;

and designed principally for the use of the occupants of such buildings; and, all rooms and apartments used for public assemblages of less than one hundred (100) persons are classified as minor assembly halls and shall be designed, constructed and equipped as prescribed for club and lodge buildings (see Part 2, Title 6).

TITLE 6—CLUB AND LODGE BUILDINGS

CLASSIFICATION

SECTION 1. Under this classification are included all buildings or parts of buildings containing an assembly hall, lodge, social, recreation, exercise, or other rooms, used by a fraternal, social, military or other organization for the private assemblage of persons, including all ante and other rooms of utility used in connection therewith, when such buildings or parts of such buildings are not rented or let out for the use of the general public.

All rooms or apartments in club and lodge buildings not included in the various classifications of the different Titles of Part 2 and not a customary or necessary adjunct thereto are herein classified as minor assembly halls.

This classification also includes assembly halls and churches built in connection with and as a necessary adjunct to a school building, hospital, hotel, workshop, factory or mercantile establishment or similar building or institution, and used for private gatherings and designed principally for the use of the occupants of such buildings; and, all rooms or apartments used for public assemblages of less than one hundred (100) persons, all of which are herein classified as minor assembly halls.

This classification does not include buildings designed as residences for single families and used as a club house.

(For minor theaters see Section 27.)

(For use of motion picture machines in minor assembly halls see Part 2, Title 1, Section 15.)

CLASS OF CONSTRUCTION

SECTION 2. No minor assembly hall or minor theater in an "A" grade school building of fire-proof construction shall

be placed more than twenty-three (23) feet nor in a building of composite construction more than ten (10) feet above the grade at any entrance to or exit from the same; and, no minor assembly room for an "A" grade school building shall be placed in a building of frame construction. Such minor assembly hall shall not seat or accommodate more than the number of persons given in the following table.

No minor assembly hall used by the general public in a building of fire-proof construction shall be placed more than thirty-five (35) feet; nor, in a building of composite construction more than twenty (20) feet above the grade line at the main entrance to the building.

With the above exceptions the following table gives the maximum number of persons that shall be seated or accommo-

Maximum height above the grade.	Maximum number of persons that shall be accommodated.		
	In a building of fireproof construction.	In a building of composite construction.	In a building of frame construction.
48 feet and over	100 persons	No persons at or above	
46 feet	150 persons		
44 feet	200 persons		
42 feet	250 persons	50 persons	
40 feet	300 persons	100 persons	
38 feet	400 persons	150 persons	
36 feet	500 persons	200 persons	
34 feet	600 persons	250 persons	
32 feet	700 persons	300 persons	
30 feet	800 persons	350 persons	
28 feet	1,000 persons	400 persons	
26 feet	1,200 persons	450 persons	
24 feet	1,400 persons	500 persons	
22 feet	1,600 persons	550 persons	
20 feet	1,800 persons	600 persons	
18 feet	2,100 persons	650 persons	No person at
16 feet	2,400 persons	700 persons	or above
14 feet	2,700 persons	750 persons	50 persons
12 feet	3,000 persons	800 persons	100 persons
10 feet	3,300 persons	900 persons	150 persons
8 feet	unlimited	1,000 persons	200 persons
6 feet	unlimited	1,200 persons	300 persons
4 feet	unlimited	1,400 persons	400 persons

dated in a minor assembly hall, the maximum distance the highest point of the main floor of such minor assembly hall shall be placed above the grade at the main entrance to the building and the class of construction that shall be employed in the erection of a building containing such a minor assembly hall.

When a building containing two or more different kinds of occupancy as classified under Part 2 (see titles 3, 4, 5, 6 and 7) the entire building shall be built of the best grade of construction prescribed under the various titles of Part 2 affecting the different sections or parts of the building.

EXPOSURE AND COURTS

SECTION 3. *Exposure.*—No club or lodge building shall occupy more than ninety-five (95) per cent of a corner lot or site, nor more than ninety (90) per cent of an interior lot or site, the measurements being taken at the lowest floor line, except, a building not more than twenty-five (25) feet wide may occupy one hundred (100) per cent of a corner lot or site.

If the building contains a theater, assembly hall, or church which is rented or let out for public gatherings the walls of the theater, assembly hall or church shall abut upon streets, alleys, yards or courts, in the number and of the size as prescribed for theaters and assembly halls (see Part 2, Title 1) or churches (see Part 2, Title 2) as the case may be.

The walls of a minor theater and minor assembly hall shall abut upon streets, alleys, yards or courts of a combined width of all means of egress leading thereto, and run to and connect with public highways.

Walls containing windows lighting school or class-rooms shall not be placed nearer any other building, structure or property line than thirty (30) feet.

Courts.—The height of courts shall be measured from the top of the lowest window sill to the top of the cornice or fire wall.

If fire escapes, bay windows or other appendages are erected in or above a recess or inner court, the widths or areas of the

same shall be added to the dimensions given under the following table of widths and areas of courts.

The following table gives the minimum width and areas of the various courts that shall be employed to secure proper light and ventilation, providing the building does not contain school or class-rooms.

Height.	Inner Court.		Recess Court.	
	Width.	Area.	Width.	Area.
18 ft. and less	7 ft.	90 sq. ft.	3½ ft.	50 sq. ft.
18 ft. to 30 ft	9 ft.	122 sq. ft.	4½ ft.	60 sq. ft.
30 ft. to 45 ft	12 ft.	216 sq. ft.	6 ft.	108 sq. ft.
45 ft. to 60 ft	15 ft.	338 sq. ft.	7½ ft.	169 sq. ft.
60 ft. to 75 ft	18 ft.	486 sq. ft.	9½ ft.	243 sq. ft.
75 ft. to 90 ft	21 ft.	662 sq. ft.	10½ ft.	331 sq. ft.
90 ft. to 105 ft	24 ft.	864 sq. ft.	12 ft.	432 sq. ft.
105 ft. to 120 ft	27 ft.	1,094 sq. ft.	13½ ft.	547 sq. ft.
120 ft. to 135 ft	30 ft.	1,350 sq. ft.	15 ft.	675 sq. ft.
135 ft. to 150 ft	33 ft.	1,634 sq. ft.	16½ ft.	817 sq. ft.
150 ft. to 165 ft	36 ft.	1,944 sq. ft.	18 ft.	976 sq. ft.

If the building contains school or class-rooms recess or inner light courts may be used, providing the least distance between any two opposite walls is equal to the height from the lowest sill of a window lighting such room, to the top of the cornice or fire wall.

All walls of inner or recess courts shall be of masonry or fire-proof construction (except for buildings of frame construction).

Windows may be placed in the angles of the above courts providing the running length of the wall containing such windows shall not exceed six (6) feet.

Each inner court shall be provided with one fresh air intake, placed at the bottom of the court, and run to and connected with a street, alley or yard. If inner courts are of the same or greater size than prescribed for courts lighting school or class-rooms (see Part 2, Title 3) fresh air intakes will not be required.

Intakes shall be constructed of fire-proof material and there shall be no openings into these intakes other than the inlet and outlet.

The area of these intakes shall be of a size equal to not less than the prescribed area of the inner court, but in no case shall an intake be less than three (3) feet wide, nor less than three (3) feet high.

SUB-DIVISIONS AND FIRE STOPS

SECTION 4. A building of this classification built in connection, with or as a part of a building of a lower grade of construction, shall be separated from the other parts of the building by standard fire walls, and all communicating openings shall be covered by double standard fire doors, using a standard self-closing fire door on one side of the wall and either a standard automatic fire door or a standard automatic rolling steel door on the other side of the wall.

If the building contains a theater the same shall be provided with the necessary fire stops and fire walls as prescribed for theaters. (See Part 2, Title 1.)

Standard fire-proof walls shall sub-divide buildings of non-fire-proof construction into floor areas of not more than two thousand (2,000) square feet each, except when single rooms of a greater dimension are required, in which case the floor area above such rooms need not be divided as above prescribed.

If a building of this classification is placed over rooms or apartments of non-fire-proof construction used for other purposes, the ceiling below the same shall be lathed with incombustible lath and be plastered, or be covered with pressed or rolled sheet steel.

All rooms or apartments used for storing furniture, carpenter shops, general repairing, paint shops, ammunition or other equally hazardous purposes, shall be enclosed by standard fire-proof walls, ceilings and floors, and all openings between these rooms or apartments, and the other parts of the building shall be covered by double fire doors, using a standard self-closing fire door on one side of the wall, and a standard automatic fire door or

a standard automatic rolling steel door on the other side of the wall.

No open wells communicating between any two stories of a public hall shall be used, except the usual stair and elevator wells, and openings through not more than one successive mezzanine story.

All external and court walls of buildings more than three (3) stories high and within thirty (30) feet of any other building, structure or lot line shall be provided with the following fire stops, viz., wall shall be standard fire walls; windows shall be of the automatic type of standard fire-proof windows, and doors shall be standard hinged fire doors without automatic attachment.

HEATER ROOM

SECTION 5. Furnaces, hot water heating boilers and low pressure steam boilers may be located in the building, providing the heating apparatus, breeching, fuel and firing rooms are enclosed in a standard fire-proof heater room and all openings into the same from the other parts of the building are covered by standard self-closing fire doors.

No furnace or boiler shall be located under any lobby, exit, stairway or public hall.

No cast iron boiler operated at more than ten (10) pounds' pressure or steel boiler operated at more than thirty-five (35) pounds' pressure shall be located within the main walls of any club or lodge building.

Exceptions.—If a club or lodge building does not contain a minor assembly hall accommodating more than fifty (50) persons, a fire-proof heater room will not be required, but the entire ceiling over the apartments containing the heating apparatus, fuel, breeching and firing space, if of combustible construction, shall be lathed with incombustible lath and be plastered.

BASEMENT ROOMS

SECTION 6. No room wholly below the grade shall be used for any purpose other than storage, heating apparatus and fuel rooms.

Rooms with not more than half the height of the story below the grade may be used for storage, heater, apparatus, fuel rooms, social purposes, recreation, dining, drilling, domestic science, manual training, exercise, physical culture, baths, toilets and barber shops.

No room wholly or partly below the grade shall be used as an assembly room or for worship, religious instructions, school lodge, living or sleeping purposes.

Dining rooms, lunch rooms, bakeries and kitchens may be placed wholly or partly below the grade when the same are properly lighted by windows with stationary sash; all entrances from the streets, alleys, yards or courts are provided with vestibules with two sets of self-closing doors; no open areaways connect directly with the rooms and the rooms are provided with a mechanical system of ventilation, which will change the air not less than six (6) times per hour.

No laundry shall be placed wholly or partly below the grade unless the same is provided with a mechanical system of ventilation which will change the air not less than six (6) times per hour and the ceiling is covered with plaster or otherwise made tight.

If a club or lodge building is not located over a building used for other purposes, the first story shall be placed not less than three (3) feet above the grade and the basement shall be properly ventilated by windows or grille work.

DIMENSIONS OF ROOMS

SECTION 7. The dimensions of the various rooms or apartments shall be as prescribed under the various titles of Part 2, according to the classification and purpose for which the rooms and apartments are designed or intended to be used.

SEATS, SEAT BENCHES, AISLES AND FOYERS

SECTION 8. Seats, seat benches, aisles and foyers in minor assembly halls and churches, shall be installed as prescribed for theaters and assembly halls and churches (see Part 2, Titles 1 and 2).

In lodge and dance halls, single rows of loose chairs, seats or benches may be placed against the walls or partitions, otherwise such chairs, seats, or benches shall be installed as prescribed for theaters and assembly halls.

In rooms used for social, dancing, recreation, drilling, exercise or similar purposes the seats, chairs or benches may be portable.

Seats, desks and aisles in school or class rooms shall be installed as prescribed for school buildings (see Part 2, Title 3, Section 10).

DINING ROOMS

SECTION 9. Dining rooms are classified as minor assembly halls and shall not seat or accommodate more persons at a given height above the grade line than prescribed under Section 2.

OPTICS

SECTION 10. Windows are not required in minor assembly halls, and bath, and ante rooms when such rooms are provided with a mechanical system of heating and ventilating.

All other minor assembly halls, bath, toilet and ante rooms and stairways shall be lighted by windows placed in the external walls of the building unless the use of such hall or room will not permit, and the glass surface of such windows (except stairways) shall not be less than equal to one-tenth (1-10) the floor area of the room.

Exceptions.—All rooms and halls, except sleeping apartments and school and class-rooms may be lighted by clere story windows or skylights, providing the glass surface is of the amount prescribed for windows.

The upper half of all windows shall be so arranged as to open the full width; one-half (½) of the clere story windows shall be arranged to open; and if skylights are used, louvers, vents or other devices with closing dampers shall be installed which will provide ventilating openings equal to one-fourth (¼) the required area of the skylight.

The above openings shall be provided with operating devices by which the windows or dampers may be operated from the floor level below.

Should the building contain rooms or apartments included in the classifications of the various titles of Part 2, such rooms or apartments shall be provided with windows as prescribed under the various titles of Part 2, effecting the rooms or apartments, and their necessary appurtenances.

MEANS OF EGRESS

SECTION 11. All means of egress shall be exit doors unless the same lead to A standard fire escapes, in which case either exit doors or exit windows shall be used.

The number of persons that the building will accommodate shall be ascertained as follows:

In assembly halls with fixed seats, the seating capacity shall be established by the actual number of persons to be accommodated in seats, benches and pews; and, where the assembly hall is seated with portable seats or chairs, the capacity shall be established by allowing to each person six (6) square feet of floor area.

In all other parts of the building the capacity shall be established as follows:

Dining rooms, 15 sq. ft. of floor area per person.

Lodge rooms, 15 sq. ft. of floor area per person.

Dance halls, 15 sq. ft. of floor area per person.

Primary school rooms, 16 sq. ft. of floor area per person.

Grammar school rooms, 18 sq. ft. floor area per person.

High school room, 20 sq. ft. of floor area per person.

Other school rooms, 24 sq. ft. of floor area per person.

Social rooms, 15 sq. ft. of floor area per person.

Drill rooms, 15 sq. ft. of floor area per person.

In all other rooms means of egress shall be based on the actual number of persons to be accommodated.

Auditoriums and balconies in "A" grade school buildings of composite construction shall be provided with means of egress

the same as prescribed for school rooms in "A" grade school buildings of composite construction.

Otherwise each room, balcony or apartment used for any purpose other than storage shall have at least two (2) separate and distinct means of egress. If the various rooms connect directly with a public hall means of egress at each end of the public hall will be sufficient.

Such means of egress shall be either inside stairways running continuously from the grade to the topmost story, or from the basement to the grade; A, B, C, or D standard fire escapes; outside stone, concrete or iron steps, extending to the grade or self-closing doors leading directly to the public hall of an adjoining section of the building containing a stairway.

Means of egress shall be in the proportion to three (3) feet in width to each one hundred (100) persons to be accommodated in buildings accommodating not more than five hundred (500) persons.

When buildings accommodate from five hundred (500) to one thousand (1,000) persons, two (2) feet additional exit width shall be provided for each one hundred (100) persons or fraction thereof in excess of five hundred (500) persons.

When buildings accommodate more than one thousand (1,000) persons, one (1) foot additional exit width shall be provided for each one hundred (100) persons or fraction thereof in excess of one thousand (1,000) persons, but in no case shall an exit be less than three (3) feet or more than six (6) feet wide.

In club and lodge buildings the widths of the means of egress need not be more than necessary to accommodate the number of persons assembled under normal conditions after making the proper reduction for unoccupied rooms.

When a minor assembly hall is built in connection with and as a necessary adjunct to a school building other than of "A" grade and of composite construction; or, with or to a hospital, hotel, workshop, factory or mercantile establishment, the stairways and means of egress beyond the walls of the minor

assembly hall need not be more than prescribed for the building which the minor assembly hall serves, exclusive of the seating capacity of the minor assembly hall; but, in no case shall such stairways and means of egress be less in width than the width of the means of egress from the minor assembly hall leading thereto.

In computing the widths of exits at the foot of stairways the standing capacity of the stairway, including the landings, allowing three (3) square feet per person may be deducted from the number of persons the exit should be designed to serve.

It shall be presumed that the persons assembled will be equally distributed to the various means of egress.

"A" standard fire escapes may be installed only on buildings used exclusively by males.

Means of egress shall be so arranged as to give free access to the same without passing through more than one intervening room to a means of egress or to a public hall leading to two (2) or more means of egress.

All exits shall lead to streets or alleys, or to courts connected with public highways.

All stairways and exits (not marked by illuminated exit signs) shall have painted signs on or above the same, indicating the word "EXIT" in plain block letters not less than six (6) inches high.

STAIRWAYS

SECTION 12. All stairways shall be enclosed by standard fire walls, or by standard fire proof walls, ceilings and floors; and all openings through these walls shall be covered by standard self-closing fire doors.

In buildings of fire proof construction, these enclosures may be made of incombustible material; or made of wire glass not less than one-quarter (¼) inch thick set in metal sash and frames.

No wire glass shall be used in partitions separating stairways from rooms containing highly combustible materials.

The width of stairways shall be at the ratio of three (3) feet per one hundred (100) persons accommodated in buildings

accommodating not more than five hundred (500) persons, when buildings accommodate from five hundred (500) to one thousand (1,000) persons two (2) feet of additional stairway width shall be provided for every one hundred (100) persons or fraction thereof in excess of five hundred (500), when buildings accommodate more than one thousand (1,000) persons, one foot additional stairway width shall be provided for every one hundred (100) persons or fraction thereof in excess of one thousand (1,000) persons.

In club and lodge buildings the width of the stairways need not be more than necessary to accommodate the number of persons assembled under normal conditions after making the proper reduction for unoccupied rooms.

In computing the widths of stairways, the standing capacity of the stairway, including the landings, allowing three (3) square feet per person may be deducted from the number of persons the stairway should be designed to accommodate.

No stairway shall be more than six (6) feet nor less than three feet six inches (3′ 6″) wide, measuring in the clear between the hand rails.

Where stairways more than six (6) feet wide are required, the same shall be divided by a substantial center hand rail with newel and angle posts not less than six (6) feet high, which shall divide the stairway into widths not less than three feet six inches (3′ 6″) and not exceeding six (6) feet wide.

The rise and tread of stairways shall be as follows:

Stairways used by servants only, riser not more than eight (8) inches, and tread not less than nine (9) inches; used by adults, riser not more than seven and one-half (7½) inches, and tread not less than ten (10) inches; used by children, riser not more than six and one-half (6½) inches, and tread not less than eleven (11) inches.

No riser shall be less than five (5) inches. The above dimensions shall be from riser to riser and from tread to tread.

No stairway shall have more than sixteen (16) nor less than three (3) risers in any run.

No winders shall be used and all nosings shall be straight.

Hand rails shall be provided on both sides of all stairways and steps.

A uniform width shall be maintained in all stairs and stair platforms by rounding or beveling, the angles and corners.

No door shall open directly upon a stairway, but shall open on a platform equal in width to the width of the door.

No closet for storage shall be placed under any stairway.

No stairway shall lead downward to a platform and then upward to a new level, or vice versa, except steps in balcony aisles.

At least one-half of the stairways shall have grade platforms with exit doors not less than three (3) feet wide opening upon streets, alleys, yards or courts leading to public thoroughfares, when such stairways are used in place of fire escapes.

Stair treads shall be covered with rubber or lead mats securely fastened to place, the treads formed of non-slipping surfaces or be covered with carpet as prescribed under Maintenance of Buildings (see Part 11, Title 1, Section 8).

Outside areas and steps shall be provided with guard rails not less than two feet six inches (2′ 6″) high.

Monumental Stairways and Steps.—Monumental stairways may be used for the basement to the second story when there are no sleeping rooms in any story communicating with such stairways; or monumental stairways may be used when placed as far distant from the other stairways as possible and supplied in addition to the other stairways and means of egress required.

Monumental stairways may be of a greater width than six (6) feet measuring between the hand rails and such stairways need not be provided with more hand rails than would be necessary for the actual width required as a means of egress.

Monumental steps from the grade to the first story with more than five (5) risers, shall be provided with hand rails on both sides of the same; and such steps with five (5) or less risers need not be provided with hand rails.

GRADIENTS AND INCLINES

SECTION 13. To overcome any difference in floor levels which would require less than three (3) risers, gradients shall be employed of not to exceed one (1) foot in rise in twelve (12) feet of run.

PASSAGEWAYS

SECTION 14. Public halls, shall be so designed and proportioned as to prevent congestion and confusion.

No public hall leading to a stairway or exit shall be less in width than the stairway or exit, and in no case less than four (4) feet wide.

Any stairway or public hall shall be of equal capacity to the aggregate width of all stairways or public halls which it serves as a means of egress.

ELEVATORS

SECTION 15. Elevators shall not be considered or computed as a means of egress.

(For the construction of elevators and elevator shafts, see Elevators, Part 8.)

EXIT DOORS

SECTION 16. Doors to rooms occupied by less than ten (10) persons are not included under the classification of exit doors.

Exit doors shall not be less than three (3) feet wide, nor less than six feet four inches (6′ 4″) high, and shall be level with the floor, swing outward, viz., towards the open or the natural means of egress, and be so hung as not to interfere with passageways or close openings, stairways or fire escapes.

No single door or leaf to a double door shall be more than four (4) feet wide.

No two (2) doors hinged together shall be used as a means of egress or ingress.

Accordion doors may be used to divide social rooms, providing the free section wings outward and provides the required amount of exit width.

No double acting, revolving, sliding or rolling doors shall be installed where used or liable to be used as a means of ingress or egress; except as previously prescribed under sub-divisions and fire stops (Section 4).

Sliding or rolling doors may be used to divide social rooms, providing they are installed in addition to the prescribed means of egress.

(For exit windows see Standard Devices, Part 3, Title 7, Section 6.)

SCUTTLES

SECTION 17. Every building exceeding twenty-five (25) feet in height shall have in the roof a bulkhead or scuttle not less than two (2) feet wide and not less than three (3) feet long, covered on the outside with metal, and provided with a stairway or permanent ladder leading thereto.

Bulkhead and scuttle doors shall not be provided with locks.

SPECIAL CONSTRUCTION

SECTION 18. All floors to toilet rooms, lavatories, water-closet compartments and any enclosure where plumbing fixtures are used within the building, shall have a water-proof floor and base as prescribed under Sanitation (see Part 4, Title 12, Section 1).

All basements shall have damp-proof or water-proof floors properly drained to carry off surface water.

No garbage chute shall be erected in or be connected with any building included in this classification.

FLOOR AND ROOF LOADS

SECTION 19. In calculating construction, the superimposed load on the various floors and roof shall be assumed at not less than the following:

In halls used for dancing, one hundred and fifty (150) pounds per square foot.

In auditoriums with fixed seats, eighty (80) pounds per square foot.

In auditoriums or lodge rooms with movable seats, one hundred (100) pounds per square foot.

In public halls and stairways one hundred (100) pounds per square foot.

In social rooms not used for dancing, eighty (80) pounds per foot.

In sleeping apartments and private halls, fifty (50) pounds per square foot.

In school rooms, sixty (60) pounds per square foot.

In dining rooms, one hundred (100) pounds per square foot.

In drill rooms, one hundred and fifty (150) pounds per square foot.

In attics not used for storage twenty (20) pounds per square foot.

For roofs, forty (40) pounds per square foot.

HEATING AND VENTILATING

SECTION 20. Minor assembly halls used for drilling, dancing, exercises or similar purposes when the persons assembled therein are in action shall be heated to sixty (60) degrees in zero (0) weather, and all other minor assembly halls shall be heated to seventy (70) degrees in zero (0) weather.

All minor assembly halls not provided with windows or skylights, minor assembly halls used by the general public, minor assembly halls used for lodge purposes, and all assembly halls and churches used in connection with and as a necessary adjunct to school buildings, hospitals, hotels, workshops, factories, mercantile establishments shall be provided with a combination heating and ventilating system which will change the air at normal temperature not less than four (4) times per hour in lodge rooms and not less than six (6) times per hour in all other rooms. In sparsely occupied or lofty rooms the air supply may be reduced to twelve hundred (1200) cubic feet of air per person.

(See means of egress Sec. 11 for the method of establishing the capacity of the rooms.)

The system to be installed when a change of air is required shall be either standard ventilating stoves, a gravity or mechanical furnace system, a gravity indirect steam or hot water system, a mechanical steam or hot water system, or a split steam or hot water system.

Bakeries, laundries and kitchens shall be provided with a system of ventilation which will remove the air not less than six (6) times per hour.

Open grates may be used in social rooms but shall not be used in any assembly or lodge room, or public hall.

If stoves are used in public halls the same shall be enclosed in substantial screens or guard rails.

If the building contains rooms or apartments included in the classifications of the various titles of Part 2, such rooms or apartments shall be provided with a system of heating and ventilating as prescribed under the various titles of Part 2, affecting the different rooms or apartments, and their necessary appurtenances.

SANITATION

SECTION 21. Where a water supply and sewerage system are available a sanitary equipment shall be installed within the building as follows:

If the building is used by males and females, separate toilet rooms shall be provided for each sex, and the traveling distance between the entrance doors to such toilet rooms shall not be less than twenty (20) feet.

No toilet room shall connect directly with any kitchen, dining room or other room where edibles are prepared or consumed.

The number of plumbing fixtures to be installed in club and lodge buildings shall not be less than given in the following table. The same shall be based on the maximum number of persons to be accommodated under normal conditions after making the proper reduction for unoccupied rooms.

(See means of egress, section 11 for the method of establishing the capacity of the rooms.)

One lavatory to each one hundred (100) persons or fraction thereof.

One water closet to each seventy (70) females or fraction thereof.

One water closet to each one hundred (100) males or fraction thereof.

One urinal to each one hundred (100) males or fraction thereof.

One drinking fountain to each one hundred (100) persons or fraction thereof.

Minor assembly halls built in connection with and as a necessary adjunct to a school building, hospital, hotel, workshop, factory or mercantile establishment need not be supplied with any sanitary equipment other than that prescribed for the buildings, which it serves.

Lavatories shall not be provided with waste plugs or stoppers.

Drinking fountains giving a continuous flow of water or operating by a ring or foot valve shall be installed.

If a water supply and sewerage system are not available no sanitary equipment shall be installed within the building; but pumps (in lieu of drinking fountains), water closets and urinals in the above proportions shall be placed on the building ground, and no water closet or urinal shall be placed nearer any occupied building than twenty (20) feet.

Toilet rooms for males shall be clearly marked "Men's Toilet" or "Boys' Toilet" and for females "Women's Toilet" or "Girls' Toilet."

LIGHTING

SECTION 22. Minor Assembly Halls which are not kept lighted during the entire performance or entertainment or during the time the same are occupied shall be provided with illuminated exit signs as prescribed for theatres and assembly halls; except two separate services will not be required.

All public halls, stairways and toilet rooms and all rooms or apartments leading to the means of egress shall be provided

with a sufficient number of gas, vapor or electric lights, properly located to amply light the same at night.

Lamps may be used for lighting only when gas, vapor or electricity is not available.

All buildings of this classification if wired for electric power or lighting shall be wired in conduit or armored cable as prescribed under electrical work (See Part 7).

FINISHING HARDWARE

SECTION 23. All entrance and exit doors shall be equipped with hardware of such a nature as to be always unlockable from within.

Single outside doors used for egress only shall have one knob, latches, or double extension bolts as hereafter prescribed, and no bolts, hooks or other locking device shall be placed on these doors.

Single outside doors used for ingress and egress shall have locks that may be locked from the outside only, but can always be operated from the inside by simply turning the knob or lever or by pushing against a bar or plate. No attachments shall be placed on these locks, which will interfere with their free and immediate operation at all times and no bolts, hooks, thumb latches or other locking devices shall be used.

One of each pair of double doors shall be equipped with a double extension bolt on one door, operated by a knob, lever, push bar, push plate, push handle or other device whereby the simple act of turning a knob or lever, or pushing against a bar, plate or handle will release the top and bottom bolt at the same time.

No independent top and bottom bolts shall be used.

Locks for these doors shall be as prescribed for single exit doors.

All bolts, latches, face of locks, working parts of extension bolts and other exposed working parts about this hardware shall be of cast metal properly protected from corrosion.

(For hardware for exit windows see Standard Devices, Part 3, Title 7, Section 6.)

FIRE EXTINGUISHERS

SECTION 24. Where a water supply of sufficient pressure to reach the various portions of the building is available all rooms or apartments used for storing of furniture, carpenter shops, general repairing, paint-shops or other equally hazardous purposes shall be provided with standard automatic sprinklers.

Club and lodge buildings and minor assembly halls shall be equipped with either standard stand pipes and hose or standard chemical fire extinguishers.

When stand pipes and hose are installed, one standard stand pipe with a line of one and one-half (1½) inch hose shall be placed in the basement and each tier and story and when such lines of hose will not reach the extreme portions of the building additional stand pipes and hose shall be installed.

All stand pipes and hose shall be placed in the public parts of the building prominently exosed to view and always accessible.

When chemical fire extinguishers are used, one chemical fire extinguisher shall be placed as follows, viz.: one in each kitchen, one in each storage room, one in each heater room, and one in each basement, tier, level and story to each two thousand (2,000) square feet of floor area or less.

FIRE ALARM

SECTION 25. Club and lodge buildings more than two (2) stories high shall be equipped with an eight (8) inch trip fire gong with connections enabling the ringing of the same from any story or basement.

Minor assembly halls need not be provided with fire alarms other than prescribed for the building which they serve.

PROHIBITED LOCATION

SECTION 26. No club or lodge building shall be placed over a stable, barn, hay mow, garage, dry cleaning establishment, fire department building, planing mill, carpenter shop, or paint shop.

SECTION 27. When a club or lodge building or minor assembly hall contains a stage and scenery as hereinafter described, such hall, room or place of assemblage is classified as a minor theatre and such minor theatre shall comply with all the prescribed conditions for club and lodge buildings with the following exception.

A stage containing not to exceed one permanent set of scenery the entire set including the drop curtain containing not to exceed six hundred (600) square feet of surface, all scenery fireproofed as prescribed for theatres (see Part 2, Title 1, Section 37) and containing no transient scenery is classified as a minor theatre and may be used in connection with a minor assembly hall and need not be provided with fire stops, asbestos curtain or stage ventilator; otherwise such a minor theatre shall be designed, constructed and equipped as prescribed for assembly halls.

A stage built in excess of the above requirement but containing not to exceed three entrances (scenery term) not over fifteen (15) feet deep, not over twenty-five (25) feet wide, all scenery fireproofed as prescribed for theatres (see Part 2, Title 1, Section 37) and containing no traps or transient scenery is classified as a minor theatre and may be built in connection with a minor assembly hall under the following conditions, viz.: the stage shall be separated from the auditorium or other parts of the building by standard fireproof walls, ceilings and floors and all communicating openings through these walls shall be covered by standard automatic or self-closing fire doors; the area of the automatic stage ventilator may be reduced to one-sixteenth (1/16) the area of the stage, the proscenium opening shall be covered by a proscenium curtain as prescribed for theater (see Part 2, Title 1, Section 17), otherwise the stage shall be designed, constructed and equipped as prescribed for theaters and the auditorium designed, constructed and equipped as prescribed for minor assembly halls.

Buildings containing a stage built in excess of the above limitations may have the stage located in any story providing the stage, property rooms, traps or trap space are separated from the other parts of the building by standard fireproof walls, ceilings and floors and all communicating openings are covered by standard automatic or self-closing doors.

Otherwise the stage shall be designed, constructed and equipped as prescribed for theaters (see Part 2, Title 1) and the auditorium designed, constructed and equipped as prescribed for minor assembly halls.

MOTION PICTURE MACHINE AND BOOTH

SECTION 28. Motion picture machines may be used in a club or lodge building, or minor assembly hall when such picture machine is used to illustrate educational or ritualistic work and the general public is not admitted thereto.

Such motion picture machine before being operated shall be installed in a motion picture machine booth (see Part 2, Title 1, Section 15).

HEATING AND VENTILATING SYSTEMS

In accordance with the State Building Code relative to Theaters, Assembly Halls, Churches and School Buildings and the requirements of the Ohio State Department of Inspection of Workshops, Factories and Public Buildings relative to Hospitals, Asylums and Homes, and General Installation.

CLASSIFICATION

A. *Theaters.*—Includes all buildings containing a stage with movable scenery or a motion picture machine.

B. *Assembly Halls.*—Includes all Assembly Halls or rooms, except Churches and Theaters.

C. *Churches.*—Includes all buildings used for Christian worship or religious instruction.

D. *School Buildings.*—Includes all Public, Parochial and private Schools, Colleges, Academies, Seminaries, Libraries, Museums and Art Galleries.

E. Asylums, Hospitals and Homes.—Includes all buildings used for the detention, refuge, protection, treatment or care of the abandoned, homeless, infirm, helpless, blind, deaf, diseased in body or mind, incorrigible youths and felons.

(This classification does not include Hotels, Tenement Houses or Private Residences.)

TEMPERATURE

A heating system shall be installed which will uniformly heat the various parts of the building to the following temperatures in zero weather.

Theatres and Assembly Halls.—All parts of the building, except storage rooms, to 65 degrees.

Churches.—Auditoriums, social and assembly rooms, 65 degrees.

All other parts of the building, except storage rooms to 70 degrees.

School Buildings.—Corridors, hallways, play rooms, toilets, assembly rooms, gymnasiums and manual training rooms, 65 degrees.

All other parts of the building to 70 degrees.

Hospitals, Asylums and Homes.—Operating rooms, 85 degrees.

All other parts of the building, except storage rooms, to 70 degrees.

CHANGE OF AIR

The heating system shall be combined with a system of ventilation which at normal temperature will change the air the following number of times or supply to each person the following number of cubic feet of air per hour.

Theatres.—Parlors, retiring, toilet and check rooms, six changes per hour.

Auditoriums, 1,200 cubic feet of air per person per hour.

Assembly Halls.—When used in connection with a school building, lodge building, club house, hospital or hotel, six (6)

changes per hour; and in all other assembly halls twelve hundred (1,200) cubic feet of air per hour per person.

Churches.—Auditoriums, assembly rooms and social rooms six (6) changes per hour.

School Buildings.—All parts of the building, except corridors, halls and storage rooms, six (6) times per hour.

Asylums, Hospitals and Homes.—Rooms with fixed capacity.

	Adult	*Children*	*Babies*
Hospitals, contagious and epidemic	6,000	4,000	3,000
Hospitals, surgical and medical	3,000	2,400	1,500
Penal Institutions	1,800	1,800	....
All other buildings	1,800	1,500	....

Rooms with variable capacities.

Hospitals, epidemic and contagious	12 times per hour
Hospitals, surgical and medical	12 times per hour
All other buildings	6 times per hour

Rooms accommodating four or less persons need not be provided with a system of ventilation.

RADIATORS

No radiators shall be placed in any aisle, foyer or passageway of a new Theater, Assembly Hall or Church, but such radiators may be placed in recesses in the walls.

REGISTERS

No floor registers shall be used in Theatres, Assembly Halls, or Hospitals.

No floor registers, except foot warmers shall be used in a school building.

Floor registers may be used in churches.

Otherwise all vent registers shall be placed not more than 2 inches above the floor line, and warm air registers not less than eight (8) feet above the floor line (except when such registers are used when a change of air is not prescribed).

Cast iron registers must be fifty (50) per cent and wire screens ten (10) per cent larger than the prescribed area of the flue opening.

SYSTEMS TO BE INSTALLED WHERE A CHANGE OF AIR IS REQUIRED

The system to be installed when a change of air is required shall be either a gravity or mechanical furnace system, gravity indirect steam or hot water system; mechanical indirect steam or hot water system, or split steam or hot water system, except in hospitals where a direct-indirect system may be used in connection with an exhaust fan.

The fresh air supply shall be taken from outside the building and no vitiated air shall be reheated.

All vitiated air shall be conducted through flues or ducts and be discharged above the roof of the building.

Exceptions.—Standard ventilating stoves may be used in the following buildings:

Assembly halls seating less than one hundred (100) persons.

Churches seating less than one hundred (100) persons.

All school buildings, hospitals, asylums and homes.

(See pamphlet on standard ventilating stoves.)

(The table for flue sizes being for six (6) changes per hour, for other changes these dimensions shall be increased or decreased in direct proportion.)

STOVES AND GRATES

Theater and Assembly Halls.—No stove or open grate shall be used.

Churches.—No stoves shall be used except standard ventilating stoves which may be used in churches seating less than one hundred (100) persons.

No open grates shall be used in auditoriums, assembly halls or Sunday school rooms.

School Buildings.—Stoves may be used.

Hospitals, Asylums and Homes.—No stove or open grate shall be used in any part of the building, used by the inmates or patients, unless the same be enclosed by substantial metal guards

of not less than two (2) inch mesh placed at no point nearer the stove or grate than four (4) inches.

PROHIBITED BOILER PRESSURE

No cast iron boiler carrying more than ten (10) pounds pressure or steel boiler carrying more than thirty-five (35) pounds pressure shall be located within the main walls of any new or existing building.

FURNACES

Furnaces may be used in all classes of buildings.

Furnaces shall be connected to masonry hot air flues, which will carry the heated air up and enter same into rooms at a height of at least eight (8) feet above the floor level.

In churches, heated air from furnaces will be allowed to enter into rooms through floor registers, but masonry flues must be provided for all other buildings. All furnace pipes must be wrapped with at least three (3) thicknesses of asbestos paper, and must be kept at least eight (8) inches away from wood ceiling, joists, etc., and all wood work must be protected by placing one-quarter (¼) inch thick asbestos board over pipes, same being at least twelve (12) inches wider than pipes on both sides. All floor boxes shall be kept at least one (1) inch away from all wood work, and all these spaces shall be lined with one-quarter (¼) inch asbestos board before metal floor box is placed in position.

GRAVITY INDIRECT HOT WATER OR STEAM RADIATOR SYSTEM

Indirect hot water or steam radiators shall be located in basement fresh air rooms directly at the base of masonry hot air flues, and shall be properly connected to same with galvanized iron housing.

Hot air flues, protecting wood work, outside fresh air connections, etc., same as above specified for furnace work, shall be used in connection with indirect radiators.

Indirect Radiating Surface for Heating and for Ventilating Purposes.—One square foot of radiating surface shall be

provided to heat not more than the following number of cubic feet of air per hour.

Height	*Steam*	*Hot water*
First story	200	125
Second story	250	160
Third story	300	200
Fourth story	250	235

For Heating Wall and Glass Surfaces.—The amount of radiating surface for the heating of the glass and wall surface shall not be less than that obtained by adding together the glass surface and one-fourth (¼) the exposed wall surface, both in square feet, and multiplying by the following factors:

Height	*Steam*	*Hot water*
First story	0.7	1.05
Second story	0.6	0.9
Third story	0.5	0.75
Fourth story	0.4	0.5

Accelerating Coils for Vent Flues.—Vent flues used in connection with a gravity indirect steam or hot water system shall be provided with accelerating coils placed one (1) foot above the vent openings.

One square foot of radiating surface shall be provided to heat not more than the following number of square inches of area in the ventilating flue.

Height of flue	*Steam*	*Hot water*
Four stories	35	21
Three stories	30	18
Two stories	25	15
One story	20	12

The above story heights shall be from the inlet to the outlet of the flue.

The accelerating coils or radiators shall be placed with the lower part at the back of the vent flue and inclined upward and toward the front.

MECHANICAL FAN PLENUM SYSTEM

This system shall be so designed with furnaces or tempering coils and blast coils to furnish heated air, to have cleaning screens, fan plenum chamber, galvanized iron or masonry hori-

zontal ducts, masonry hot air flues, electric motor, gas or gasoline engine, or a low pressure steam engine operating on a steam pressure not to exceed thirty-five (35) pounds to operate fan and such other device as is necessary to make this a complete working system. All parts and apparatus in connection with system, to be of ample size to make a perfectly free and easy working system, and to thoroughly heat all portions of the building without forcing.

PIPE COVERING

All steam and hot water main and return piping shall be covered with sectional asbestos pipe covering.

Main and return steam piping where used as radiation in finished portions of buildings need not be covered. All pipes passing through floors, walls, etc., shall have metal protecting sleeves or collars entirely through the floor, wall, etc., and flanging out on both sides for pipes to pass through.

AIR AND FLOOR SPACE

The minimum cubic feet of air space or the minimum floor space to be allowed per person shall not be less than the following:

Theaters, Assembly Halls and Churches.—Where fixed seats are used, by the actual number of persons to be accommodated.

Where portable seats and chairs are used, six (6) square feet of floor space shall be allowed per person.

In dining rooms, lodge rooms, dance halls, social rooms, and drill halls, fifteen (15) square feet of floor space shall be allowed per person.

School Buildings.—Primary grades, 200 cubic feet.

Grammar grades, 225 cubic feet.

High school, 250 cubic feet.

All other buildings, 300 cubic feet.

Kind of occupancy.	Cubic feet of air space.		
	Adults	Children	Babies
Private rooms, hospitals	900	675	500
Dormitories, hospitals	820	600	400
Cells, penal institutions	400	400	....
Private rooms, other buildings	700	540	300
Dormitories, other buildings	550	325	225

VELOCITY OF AIR

The velocity of the air traveling through ducts, flues, etc., shall never exceed the following number of feet per minute:

Ducts, Flues, Etc.	*Feet per minute.*
Fresh air screens (small mesh)	600
Fresh air ducts, gravity system	300
Fresh air ducts, mechanical system	850
Tempering coils, gravity system	300
Tempering coils, mechanical system	1,000
Furnaces, gravity system	400
Furnaces, mechanical system	900
Trunk ducts, mechanical system	1,000
Laterals, branches and single ducts, mechanical system	750
Vertical flues, mechanical system	500
Vertical warm air flues, gravity system, first story	300
Vertical warm air flues, gravity system, second story	350
Vertical warm air flues, gravity system, third story	390
Vertical vent flues less than 20 feet high	300
Vertical vent flues 20 to 33 feet high	350
Vertical vent flues 33 to 46 feet high	390
Vertical vent flues 46 to 60 feet high	440
Warm air registers	300
Vent registers	300

For flues, ducts, etc., used in connection with stoves, see pamphlet on Standard Ventilating Stoves.

MAXIMUM SPEED OF FANS

The maximum speed of fans used in connection with either an exhaust or plenum system of heating or ventilating, under normal conditions shall never exceed the following:

Diameter of fan in inches.	*Revolutions per minute.*
18	700
24	550
36	400
48	300
60	225
72	175
96	150
120	125
180	75

TEMPERATURE REGULATION

Either a manually operating or mechanically operating system of temperature control for mixing hot and cold air in flues, shall be installed in connection with all heating systems, except gravity furnace systems installed in churches; and, for gravity steam or hot water heating when used for the change of air only and the radiators connected therewith shall not be valved.

Cold air by-pass connections shall be made from fresh air intakes or rooms to the hot air flues, and a valve shall be arranged in flue so that the hot and cold air can be mixed in flue to regulate the temperature; this valve shall be manually operated by handle and dial located in each school room, or by mechanically operated temperature regulating device.

DUCTS, FLUES AND HEATER ROOMS

In accordance with the State Building Code relative to Theaters, Assembly Halls and Churches, and the requirements of the Ohio State Department of Inspection of Workshops, Factories and Public Buildings relative to Hospitals, Asylums and Homes, and General Installation.

HOT AIR AND VENT FLUES—CONSTRUCTION OF

All hot air and vent flues thirteen by thirteen (13x13) inches or smaller in size shall be enclosed in four (4) inch brick walls and all flues larger in size shall be enclosed in eight (8) inch brick walls, these flues being smoothly plastered on inside with Portland cement mortar. Division walls in flues can be

four (4) inches in thickness. All flues shall start at ground on substantial foundations, or be supported by fireproof construction extending to the ground, and all vent flues shall extend through and above the roof, except as below stated. All hot air flues shall have arched top back of registers, to turn hot air into rooms.

In fireproof buildings the vertical flues may be made of galvanized iron enclosed by tile walls or by partitions made of metal studs, metal lath and plaster.

In all classes of construction twenty (20) gauge galvanized iron flues enclosed with two (2) inches of reinforced concrete, will be accepted in place of four (4) inch brick walls, and twenty (20) gauge galvanized iron flues enclosed with four (4) inches of reinforced concrete will be accepted in place of eight (8) inch brick walls.

When an exhaust fan is placed in the attic twenty (20) gauge galvanized iron ducts or flues may be used to connect the vertical flues to the fan.

In buildings of composite construction a weighted fire door or damper shall be placed at the top of each vertical flue and in buildings of fireproof construction, one such damper shall be placed close to the fan and so located as to control the air or fire travel in all ducts. These fire doors or dampers shall be held open by a fusible link, so in case of fire traveling through such duct or flue will fuse the link, release the fire door or damper and the same will close and shut off the flow of air or fire by its own weight.

LOCATION OF HEATER ROOM

No heater room shall be located under the auditorium, stage, lobby, passageway, stairway or exit of a theater; nor, under any exit, passageway, public hall or lobby of any assembly hall, church, school building, asylum, hospital or home. This applies to new buildings, and a changed location of a heater room in an existing building.

STANDARD FIREPROOF HEATER ROOM FOR NEW BUILDING

All furnaces and boilers including the breeching, fuel rooms and firing spaces shall be enclosed by brick walls not less than

twelve (12) inches thick or by monolithic concrete walls not less than eight (8) inches thick; and the ceiling over the same shall not be less than the following, reinforced concrete slab four (4) inches thick, brick arches four (4) inches thick covered with an inch of cement mortar and supported by fireproof steel with the necessary tie rods, or by hollow tile arches six (6) inches thick covered with two (2) inches of concrete, plastered on the under side and supported by fireproof steel with the necessary tie rods.

All openings in the above apartments from the outer parts of the building shall be covered by standard self-closing fire doors.

HEATER ROOMS FOR OLD BUILDINGS

In old buildings, the boiler or furnace and fuel rooms, shall be enclosed in same masonry walls and shall have standard fire doors on opening to same, and the entire ceiling shall be fireproofed as follows: First overlay the entire ceiling with one-quarter (¼) inch asbestos board, lapped at least one and one-half (1½) inches in joints, then furr same with one and one-half (1½) inches high metal furring spaced twelve (12) inches on centers; then lath with metal lath and heavily plaster with asbestos and Portland cement plaster.

THE CEILING OF HEATER AND FUEL ROOMS IN OLD BUILDINGS MAY BE FIREPROOFED ACCORDING TO THE FOLLOWING SPECIFICATIONS

Materials.—Furring strips shall be of corrugated asbestos lumber one-quarter (¼) inch thick, or corrugated metal reinforced with asbestos, in strips five (5) inches wide, one and one-half (1½) inches high, ninety-six (96) inches long.

Ceiling finish shall be asbestos lumber or asbestos wood forty-two by ninety-six inches by one-quarter (42x96x¼) inches thick.

Batten over end butt joist shall be asbestos lumber or asbestos wood three by forty-two by one-quarter (3x42x¼) inches thick.

Cove in angles of ceiling shall be asbestos lumber or asbestos wood two by one-quarter (2x¼) inches thick.

Method of Erection.—Furnish and erect on the under-side of ceiling joist, furring strips of corrugated asbestos lumber, or corrugated metal reinforced asbestos, running in opposite directions to the joists.

These furring strips shall be spaced twenty-one (21) inches on centers, and nailed to every bearing with two (2) eight penny nails.

Nails shall be driven directly through strips.

On these furring strips furnish and erect a ceilng finish of forty-two by ninety-six by one-quarter (42x96x¼) inches asbestos lumber or asbestos wood laid the long way of the furring strips.

The lumber or wood shall be so spaced as to break joints over the furring strip joints, and joints in finishing sheet shall be broken every course.

Sheets shall be screwed to the furring strips using a No. 8 screw one and one-quarter (1¼) inches long countersunk.

Each sheet shall have three (3) rows of screws. One row on each side and one in the center, running with the furring strips. Center row of screws shall start and finish three-quarters (¾) inch from the end of the sheets, and the side row of screws shall be spaced one and one-quarter (1¼) inches from the edges of the sheet and start and finish three-quarters (¾) of an inch from the end of the sheets.

There shall be seven (7) screws in each row spaced equally between the end screws; these screws shall be staggered to miss the nails in the furring strips. Furring strips and ceiling boards shall be drilled for screws, using drill one size smaller than the screws.

Cove.—Erect in all the angles between the ceiling and the side walls a two by one-quarter 2x¼) inch asbestos lumber or asbestos wood cove, screwed through the ceiling material into the furring strips and nailed in the masonry walls.

Cove shall be drilled for nail and screw holes using a drill one size smaller than the nail or screw.

Joints.—All joints in furring strips, ceiling boards and cove shall be tight butt joints.

All end butt joints in ceiling boards shall be covered with three by forty-two by one-quarter (3x42x¼) inch thick asbestos lumber or asbestos wood batten secured by screws through the ceiling board into joists or furring strips.

Batten shall be drilled for screw holes, using drill one size smaller than the screw. The batten shall form a butt joint into the upper leg of the cove. All joints in furring strips, cove where battens butt into cove, and all open joints due to uneven base where ceiling is erected, shall be pointed up with electrobestos or other fireproof cement of equal quality.

DEPARTMENT OF WORKSHOPS, FACTORIES AND PUBLIC BUILDINGS,

THOS. P. KEARNS,
Chief Inspector.
LESTER REDDING,
Ass't Chief Inspector.

THE PENNSYLVANIA LAW

GROUNDS AND BUILDINGS

SECTION 601. The board of school directors of each district shall provide the necessary grounds and suitable school buildings to acocmmodate all the children between the ages of six and twenty-one years, in said district, who attend school. Such buildings shall be constructed, furnished, equipped, and maintained in a proper manner as herein provided, suitable provisions being made for the heating, ventilating, and sanitary conditions thereof, so that every pupil in any such building may have proper and healthful accommodations.

SECTION 615. After the organization of the State Board of Education provided for in this act, no public school building shall be contracted for, constructed, or reconstructed, in any

school dstrict of the second, third, or fourth class, until their plans and specifications have been submitted to the State Board of Education, and any recommendations concerning the same by the State Board of Education have been laid before the board of school directors: Provided, When any school building is being constructed or remodeled at the time of the approval of this act, or when a contract has been awarded for the construction or remodeling of any school building, such building may be constructed or remodeled without being subject to the provisions of this section.

SECTION 616. The State Board of Education shall cause to be prepared and shall, at the expense of the Commonwealth, publish, and upon application furnish without charge, to boards of school directors, plans and specifications of different kinds of school buildings suited to the needs of the public schools: Provided, That school buildings may be built according to plans and specifications thus furnished, without submitting the same to the State Board of Education.

SECTION 617. Every contract in excess of three hundred dollars ($300.00), made by any school district in this Commonwealth, for the introduction of heating, ventilating, or lighting systems, or the construction, reconstruction, or repair of any school building, or work upon any school property, shall be awarded to the lowest and best bidder, after due public notice has been given, upon proper terms asking for competitive bids.

SECTION 618. All school buildings hereafter built or rebuilt shall comply with the following conditions:

In every school room the total light area must equal at least twenty per centum of the floor space, and the light shall not be admitted thereto from the front of seated pupils.

Every room shall have not less than fifteen square feet of floor space, and not less than two hundred cubic feet of air space per pupil.

SECTION 619. No board of school directors in this Commonwealth shall use a common heating stove for the purpose of heating any school room, unless such stove is in part en-

closed within a shield or jacket made of galvanized iron, or other suitable material, and o fsufficient height, and so placed as to protect all pupils while seated at their desks from direct rays of heat.

SECTION 620. No school room or recitation room shall be used in any public school which is not provided with ample means of ventilation, and whose windows, when they are the only means of ventilation, shall not admit of ready adjustment both at the top and bottom, and which does not have some device to protect pupils for currents of cold air. Every school room or recitation room shall be furnished with a thermometer.

SECTION 621. Every school building hereafter erected or reconstructed, whose cost shall exceed four thousand dollars ($4,000.00) or which is more than one story high, shall be so heated and ventilated that each school room and recitation room shall be supplied with fresh air at the rate of not less than thirty cubic feet per minute for each pupil, and which air may be heated to an average temperature of seventy degrees Fahrenheit during zero weather.

SECTION 622. All school buildings, two or more stories high, hereafter erected or leased in any school district of the first class in this Commonwealth, shall be of fireproof construction, and in any school district of the second, third, or fourth class, every building more than two stories high, hereafter built or leased for school purposes, shall be of fireproof construction.

SECTION 623. All doors of entrance into any building more than one story high, used for a public school building in this Commonwealth, shall be made to open outward, and the board of school directors of every district in this Commonwealth shall, before the opening of the school term next following the approval of this act, change the entrance doors of every such school building so that they shall all open outward.

SECTION 624. In all school buildings more than one story high, hereafter erected, all entrance doors, as well as all doors from class rooms, school rooms, cloak rooms, or other rooms into halls shall open outward.

SECTION 625. Every school building shall be provided with necessary fire-escapes and safety-appliances as required by law.

SECTION 626. The board of school directors in each school district shall put the grounds about every school building in a neat, proper, and sanitary condition, and so mantain the same, and shall provide and maintain a proper number of shade trees.

SECTION 627. The board of school directors of any district may permit the use of its school grounds and buildings for social, recreation, and other proper purposes, under such rules and regulations as the board may adopt, and shall make such arrangements with any city, borough, or township authorities for the improvement, care, protection, and maintenance of school buildings and grounds for school, park, play, or other recreation purposes, as it may see proper, and any board of school directors may make such arrangements as it may see proper, with any association or indivdual for the temporary use of school property for schools, play grounds, social, recreation, or other proper educational purposes.

SECTION 628. If any person shall wilfully or maliciously break into, enter, deface, or write, mark, or place any obscene or improper matter upon, any public school building, or other building used for school purposes, or other purposes provided for in this act, or any outhouse used in connection therewith; or shall deface, injure, damage, or destroy any school furniture, books, papers, maps, charts, apparatus, or other property contained in any public school building, or other building used and occupied for school purposes, or other purposes provided for in this act; or shall injure, damage, or destroy any shade-tree, shrubbery, fences, or any other property of any kind, upon any public school grounds, or upon any public school playground, such person shall be guilty of a misdemeanor, and upon conviction thereof shall be sentenced to pay a fine of not less than five dollars ($5.00) and not more than two hundred dollars ($200.00), or undergo an imprisonment in the county jail

for a period not exceeding six months, either or both, at the discretion of the court.

SECTION 629. The board of school directors in each district shall, when they are not otherwise provided, purchase a United States flag, flagstaf, and the necessary appliances therefor, and shall display said flag upon or near each public school building in clement weather, during school hours, and at such other times as the said board may determine.

SECTION 630. The board of school directors in any school district may, in the manner herein provided, enter into any contract with any person, firm, association, or corporation, for the furnishing of light, heat, or water to such school district, for any term not exceeding five years. The amount to become due and payable thereon, under such contract, may be distributed equally during the years over which the same extends, and only so much thereof as becomes due and payable in any one year need be provided for in the annual estimate of school expenses for any school year, and be certified to by any school controller.

SECTION 631. All school property owned by any school district, real and personal, that is occupied and used by any school district for public school, recreation, or any other purposes provided for by this act, shall be, and hereby is, made exempt from every kind of State, county, city, borough, township, or other tax, as well as from all costs or expense for paving, curbing, sidewalks, sewers, or other municipal improvements: Provided, That any school district may make any municipal improvement, in any street on which its school property abuts, or may contribute any sum toward the cost thereof.

SECTION 632. The board of school directors in every district shall, with every building used for school purposes, provide and maintain in a proper manner, a suitable number of water closets or outhouses, not less than two for each building, where both sexes are in attendance. Such water closets or outhouses shall be suitably constructed for, and used separately by, the sexes. When any water closets or outhouses are outside and detached from the school building, the entrances thereto shall

be properly screened, and they shall, unless constructed at a remote distance from each other, have separate means of access thereto, and, if possible, for not less than twenty-five feet from such water closets or outhouses, such means of access or walks leading thereto shall be separated by a closed partition, wall, or fence, not less than seven feet high.

SECTION 633. The board of school directors shall keep all water closets or outhouses, used in connection with any school building, in a clean and sanitary condition; and shall, not less than ten days prior to the opening of any term of school, and oftener if necessary, have them properly cleaned and disinfected by the use of fresh dry-slacked lime, or other proper disinfecting material.

SECTION 634. The board of school directors in every school district shall have full power and authority to make and enter into any contract or contracts it may deem proper with any person, firm or corporation, for the purpose of insuring against loss or damage by fire, or otherwise, any or all of the school buildings or other property of the school district.

SOUTH DAKOTA LAW

SCHOOL HOUSE PLANS

Plans for school buildings approved by State Superintendent: In order that due care may be exercised in the heating, lighting and ventilation of public school buildings hereafter erected, no school house shall be erected by any board of education or school district board in this State until the plans and specifications for the same showing in detail the proper heating, lighting and ventilation of such building shall have been approved by the superintendent of public instruction.

School houses shall have in each class room at least fifteen square feet of floor space, and not less than two hundred cubic feet of air space per pupil, and shall provide for an approved system of heating and ventilation by means of which each class room shall be supplied with fresh air at the rate of not less than thirty cubic feet per minute for each pupil, and have a system

of heating capable of maintaining an average temperature of seventy degrees Fahrenheit during the coldest weather.

THE UTAH LAW

SCHOOL SITES AND BUILDINGS

When necessary for the welfare of the schools of the district, or to provide proper school privileges for the children therein, or whenever petitioned so to do by one-fourth of the resident tax payers of the district, the board shall call a meeting of the qualified voters, as defined in Section eighteen hundred and eleven, at some convenient time and place fixed by the board, to vote upon the question of selection, purchase, exchange or sale of a school house site, or the erection, removal, purchase, exchange, or sale of a school house, or for payment of teachers' salaries, or for the current expenses of maintaining schools. If a majority of such voters present at such meeting shall by vote select a school house site, or shall be in favor of the purchase, exchange, or sale of a designated school house site, or of the erection, removal, or sale of a school house, as the case may be, the board shall locate, purchase, exchange or sell such site, or erect, remove, or sell such school house, as the case may be, in accordance with such vote; provided, that it shall require a two-thirds vote to order the removal of a school house.

Provided that no school house shall hereafter be erected in any school district of this State not included in cities of the first and second class, and no addition to a school building in any such place, the cost of which school house or addition thereto shall exceed $1,000, shall hereafter be erected until the plans and specifications for the same shall have been submitted to a commission consisting of the State Superintendent of Public Instruction, the Secretary of the State Board of Health, and an architect to be appointed by the Governor, and their approval endorsed thereon. Such plans and specifications shall show in detail the ventilation, heating, and lighting of such buildings. The commission herein provided shall not approve any plans for the erection of any school building, or addition thereto, unless

the same shall provide at least fifteen square feet of floor space and two hundred cubic feet of air space, for each pupil to be accommodated in each study or recitation room therein, and no such plans shall be approved by them unless provision is made therein for assuring at least thirty feet of pure air every minute for each pupil, and the facilties for exhausting the foul or vitiated air therein shall be positive and independent of atmospheric changes. No tax voted by a district meeting, or other competent authority in any such school district, shall be levied by the trustees until the commission shall certify that the plans and specifications for the same comply with the provisions of this act. All school houses for which plans and detailed statements shall be filed and approved, as required by this act, shall have all halls, doors, stairways, seats, passageways, and aisles, all lighting and heating appliances and apparatus arranged to facilitate egress in cases of fire or accident, and to afford the requisite and proper accommodations for public protection in such cases.

No school house shall hereafter be built with the furnace or heating apparatus in the basement or immediately under such school building.

The commission herein provided shall serve without compensation, but shall receive their actual and necessary expenses incurred in the performance of their official duties, except the architect, who shall receive as above provided, and four dollars per day while attending meetings of the commission, the amount for which shall be verified on oath and be paid from the state school fund.

Approved March 9th, 1909.

THE VERMONT LAW

The words, "Public Buildings," as used in this chapter, shall mean churches, school buildings, hotels more than two stories high, and places of amusement more than one story high, and buildings, factories, mills or workshops more than two stories high in which persons are employed above the second story.

Said board shall take cognizance of the interests of the life and health of the inhabitants of the state, shall make or cause to be made sanitary investigations and inquiries respecting causes of disease, especially of epidemics, and the means of preventing same; the sources of mortality and sickness and the effect of localities, employments, habits and circumstances of life on the public health, and, when requested, or when, in their opinion, it is necessary, shall advise with municipal officers in regard to drainage, water supply and sewerage of towns and villages, and in regard to the erection, construction, heating, ventilation and sanitary arrangements of public buildings; and said board may compel the owners of such buildings to provide them with the necessary appliances and fire escapes for preventing accidents to persons who may be in such buildings; and said board shall exercise the powers and authority imposed by law upon said board.

Said board shall, when necessary, issue to local boards of health its regulation as to the lighting, heating and ventilation of school houses, and shall cause sanitary inspection to be made of churches, school houses and places of public resort, and make such regulations for the safety of persons attending the same as said board deems necessary. Public buildings now standing or hereafter erected shall conform to the regulations of said board in respect to sanitary conditions and fire escapes necessary for the public health and for the safety of individuals in such public buildings.

A person, corporation or committee intending to erect a public building shall submit plans thereof showing the method of heating, plumbing, ventilation and sanitary arrangements to said board, and procure its approval thereof, before erecting such building.

A person, corporation or committee which erects a public building without the approval and without complying with the regulations of the state board of health as provided for in the preceding section, shall be fined not more than five hundred dollars, nor less than one hundred dollars, and shall make such

building to conform to the regulations of said board before the same is used, otherwise such building shall be deemed a nuisance, and be put in proper condition by the local health officer under the direction of said board at the expense of the owner.

Said board may examine or cause to be examined a school building or an outhouse and condemn the same as unfit for occupation or use, and a building or outhouse so condemned by written notice served upon the chairman of the board of school directors, or the person having such school in charge, shall not be occupied or used until the same is repaired and the sanitary conditions approved by the state board of health. A person who violates a provision of this section shall be fined not more than fifty dollars nor less than five dollars.

THE VIRGINIA LAW

(Approved March 11, 1908)

WHEREAS, It is of great importance to the people of this commonwealth that public school buildings hereafter erected by any school board shall be properly heated, lighted and ventilated; therefore,

1. *Be it enacted by the General Assembly of Virginia*, That the state board of inspectors for public school buildings shall not approve any plans for the erection of any school building, or room in addition thereto, unless the same shall provide at least fifteen square feet of floor space and two hundred cubic feet of air space for each pupil to be accommodated in each study or recitation room therein, and no such plans shall be approved by said board unless provision is made therein for assuring at least thirty cubic feet of pure air every minute per pupil, and the facilities for exhausting the foul and vitiated air therein shall be positive and independent of atmospheric changes. All ceilings shall be at least twelve feet in height.

2. All school houses for which plans and detailed statements shall be filed and approved by said board, as required by law, shall have all halls, doors, stairways, seats, passageways, and aisles, and all lighting and heating appliances and

apparatus, arranged to facilitate egress in cases of fire or accidents, and to afford the requisite and proper accommodations for public protection in such cases. All exit doors in any school house of two or more stories in height shall open outwardly. No stair-case shall be constructed except with straight runs, changes in direction being made by platforms. No doors shall open immediately upon a flight of stairs, but a landing at least the width of the doors shall be provided between such stairs and such doorway.

All school houses, as aforesaid, shall provide for the admission of light from the left, or from the left and rear of the pupils, and the total light area must be at least twenty-five per centum of the floor space.

THE WEST VIRGINIA LAW

MUST PROVIDE SITES AND BUILDINGS

The board of education of every district shall provide by purchase, condemnation, leasing, building or otherwise, suitable school houses, and ground in their districts, in such locations as will best accommodate the pupils thereof, and improve such grounds and provide such furniture, fixtures and apparatus for the said school houses, as the comfort, health, cleanliness and convenience of the pupils may require, and keep such grounds, school houses, furniture, fixtures and apparatus in good order and repair, but no board of education may purchase school apparatus of any kind without the advice and consent of the county superintendent first had in writing.

COUNTY SUPERINTENDENT SHALL APPROVE PLANS

Whenever any board of directors shall be authorized by the electors of their district to erect a school building, it shall be the duty of such board, before entering into any contract for the erection of any building, to obtain the approval of the county superintendent, of the plans and specifications for the building to be erected, including also the heating, lighting, ventilating and safety thereof.

APPROVAL OF LOCATION AND PLANS

In the construction of school houses the board of education of each district shall have regard to economy, convenience and durability of structure, and the health and comfort of pupils, and no such school house shall be constructed until the location and plan thereof have first been approved by the county superintendent, and in the event the board of education cannot agree upon plans or location, the county superintendent shall select the plans and location for such house.

OFFICIAL CODE OF THE BOSTON SCHOOL HOUSE COMMISSION

THE BOSTON CODE REQUIREMENT FOR ARCHITECTS' SERVICES

City of Boston

Every Architect employed by the Schoolhouse Commissioners of the City of Boston as the Architect for erecting a building is to perform the duties hereinafter provided.

Section 1.—*The Board.*—(*a.*) Is to furnish the Architect with the requirements and information for the design and construction of the building for which he is the Architect, and give the approximate cubical contents and proposed cost per cubic foot thereof;

(*b.*) Is to provide the services of domestic engineers to confer with the Architect during the preparation of preliminary studies, and when these are accepted by the Board to advise the Architect in the details of their work, and make the necessary working drawings and specifications for (excepting plumbing), and have the direction of, the plumbing, heating, ventilating and electric work for the building, said work being hereinafter designated as the domestic engineering;

(*c.*) Is to give the grade and lines of streets and adjoining lots;

(*d.*) Is to make all borings necessary to determine the quality of the foundations, and on request of the Architect, or of any person doing work on the building, furnish him full information relating to the above, the sewer, water, gas and electric service, and to the rights, restrictions and boundaries of the lot on which the building is to be constructed.

Sec. 2.—*The Architect.*—(*a.*) Is to consult and advise with the Board and make such preliminary studies as will acquaint the Board with the contemplated arrangement, design,

construction and cubical contents of the building, and enable it to agree with the Architect upon a definite limit of cost therefor, and to accept said preliminary studies as the basis of working drawings and specifications;

(*b.*) Is to make upon the basis of said preliminary studies one complete set of working drawings in ink on tracing cloth, floor and framing plans, sections and elevations at one-eighth scale, plumbing drawings and such detail drawings on a larger scale as are necessary to explain the specifications;

(*c.*) Is to furnish, revise and correct for the printer one complete set of specifications, including plumbing, for everything to be furnished or done in constructing the building, except the domestic engineering;

(*d.*) Is to loan to the Board, to make blueprints therefrom, the said set of working drawings;

(*e.*) Is to restudy, and if necessary redraw, without charge, any or all of said drawings and specifications, if, owing to an unwarranted departure from the approved preliminary studies or to a needlessly extravagant or elaborate interpretation of them in said drawings and specifications, the lowest bid for doing the work in accordance therewith overruns the limit of cost agreed upon by the Architect and the Board;

(*f.*) Is, upon the signing of contract, to deliver to the Board, to remain their property, two sets of blueprints, mounted on cloth, taken from the said set of working drawings, a perspective drawing of the exterior of the building and such floor plans as the Board may request, suitable for reproduction, and at the conclusion of the work a complete set of working drawings on tracing cloth, either the set previously referred to or a copy therefrom, which shall be corrected to agree with and embody all changes made during construction;

(*g.*) Is to make application for a building permit to the Building Department on a form signed by the chairman of the Board, and deliver to the Building Department two sets of such blueprints from the said set of working drawings as may be

required by the Building Department (the Board furnishing specifications to the Building Department);

(*h.*) Is to have general supervision of the domestic engineering and be the Architect of all other work to be done under any written contract for the construction of the building, and render the full usual Architect's services and supervision for such other work;

(*i.*) Is, in the form prescribed by the Board, to make all estimates and allowances for payments under any contract in which he is made the Architect of the work, and such estimates for the domestic engineering are to be accompanied by certificates of said engineers as to their accuracy;

(*j.*) Is to advise with the Board on any changes in the building contemplated by the Board, and is to order changes when required by the Board so to do;

(*k.*) Is to cause the drawings and specifications furnished by him to conform to all regulations of law and public authorities, and to be in accordance with established methods of building construction, faithfully carry out all the foregoing provisions, use all proper knowledge, skill and care therein, and be accountable for any failure so to do.

SEC. 3.—(*a.*) The city, as full compensation for the services aforesaid, is to pay the Architect 3 per cent upon the cost of the domestic engineering, exclusive of plumbing, and 6 per cent upon the cost of all other work;

(*b.*) Payments to be made as follows: 3 per cent upon all contracts other than those for domestic engineering is to be paid on the signing of such contracts, and thereafter 3 per cent upon the value of the materials and labor, as specified in each estimate for payment under the contract, is to be paid on the making of the estimate, until the full payment aforesaid is made, and if any thereof remains unpaid at the completion of the work it is then to be paid. When preliminary studies are completed, the value of the Architect's services to date shall be reckoned one-sixth of the estimated total commission; when working drawings and specifications are ready for contract, if for any reason

the signing of contracts is delayed, the value of his services to date shall be reckoned at 3 per cent of cost based on allowance for building given by the Board to the Architect. If the Board discontinue the services of the Architect at any intermediate stage the value of his services shall be reckoned proportionately. Five per cent on cost of domestic engineering, exclusive of plumbing, and 10 per cent on other work will be paid to Architects on all changes and alterations made within or to existing buildings. Additions and extensions made outside of such buildings to be regarded as new work and the commission to be reckoned on that basis.

SEC. 4.—When for any reason other than those stated in section 2, paragraph (*e*), above, the Board shall set aside the whole or any part of an Architect's studies, drawings and specifications while retaining him to prepare corresponding new studies, drawings and specifications for the same school building, the city shall pay the Architect for the work thus set aside a sum not exceeding three times the actual cost of draughting, and the new work shall be paid for on a commission basis, as stated in section 3, above.

SEC. 5.—In the above agreement the term "building" is used to define not only the structure itself but all work in connection with it committed to the Architect by the order of the Board, as fencing, grading, roads, walks, planting, decorative painting and sculptural decoration.

BOSTON SCHOOL CODE

YARDS

(1) *Grading.*—Grade the yards as determined after consultation with the commissioners.

(2.) *Fences.*—Provide fences, planting, etc., as determined after consultation.

(3.) *Gates.*—Provide the gates in fences inclosing the yards with hasp and staple to receive the Department Standard yard padlock, which will be furnished by the Department outside of the general contract.

(4.) *Play-yards.*—Play-yards located on the sunny side of the building are desired, and approximately 30 square feet per pupil should be provided. Play-yards are to be paved with hard-burned bricks, laid flat in sand and sloping at proper grades to catch-basins connecting to sewer.

(5.) *Walks.*—Pave the walks and approaches with hard-burned brick laid flat in sand.

(6.) *Curbs.*—Curbs forming borders may be paved with brick laid on edge. Bull-nose brick may be used for curbs.

(7.) *Sidewalks.*—Sidewalks for public use outside of the lot line and curbs for same are to be included in general contract for building as an allowance.

(8.) *Basement Entrances.*—Separate entrances are to be provided for boys and girls from their respective yards to the play-room. Areas, steps and inclines are to be avoided wherever possible. A separate entrance for janitor to boiler-room may be provided. A proper entrance for coal and exit for ashes should be provided.

(9.) *Driveways.*—Driveways such as for coal and ash teams are to be paved with vitrified pavers laid at the proper pitches, and in cement mortar on a sufficiently thick concrete base.

(10.) *Flagstaff.*—Provide a flagstaff with halliards, truck, etc., complete.

NOTE.—All the above items except as noted to be included in the general building contract.

ELEMENTARY SCHOOLS

In General.—Elementary schools are sub-divided into upper and lower. Lower includes Grades I., II. and III., and are to have 12-inch by 18-inch desks. The buildings for the lower grades are to have besides the class-rooms required, rooms for teachers, nurse, book storage and emergency closets. The upper elementary buildings are to contain Grades IV. to VIII., inclusive, and are to have besides the class-rooms required an

assembly hall and rooms for master, teachers, nurse, book storage and emergency closets.

Grades IV., V. and VI. are to have 15-inch by 21-inch desks and Grades VII. and VIII. are to have 16-inch by 23-inch desks.

Desks are to be spaced according to standard seating plan.

THE BUILDING

The building will be either "Lower Elementary," which includes class-rooms for Grades I., II. and III., or "Upper Elementary," which includes class-rooms for Grades IV. to VIII., inclusive. This will be determined by the Commissioners, who will act as an intermediary between architects and the school authorities and committee. Relations between commissioners, architects and contractors to be as defined by contract. Commissioners are to determine the type of construction of the building.

Orientation.—It is desired to place the building so that each class-room should receive sunlight during some portion of the day.

Setting.—Set the building above grade so that the play-rooms are well lighted and entrances are provided into basement play-rooms as before mentioned. (See Basement Entrances.) Boiler-room floor wash to drain direct to sewer wherever possible.

Heat and Vent Flues.—To be of galvanized iron or masonry, as determined by the commissioners. If of masonry, to have joints neatly struck and the inner surface fairly smooth.

Fireproofing.—The ceiling of boiler-room and coal storage should be fireproof construction if these rooms are placed under class-rooms or corridors. Doors for boiler-room and coal-pocket to be metal covered. Boiler-room to be self closing.

LOWER ELEMENTARY

This type of building, besides the required class-rooms, play-rooms, sanitaries, boiler, coal and janitor's rooms, should con-

tain rooms for teachers, nurse and book storage; also emergency closets are to be provided as directed. To have kindergarten-room where so directed by commissioners. Closets should be provided for electrician as needed for batteries, switches, etc.

NOTE.—A paper burner should be provided in connection with the boiler-room as directed.

UPPER ELEMENTARY

This type of building, in addition to the requirements for the lower elementary, should contain an assembly hall with its necessary rooms, and a master's room with waiting-room if so directed. Rooms for cooking, manual training, etc., are to be provided when called for by the commissioners.

SCHOOL-ROOMS

(1.) *Size* will be 20 by 28 for lower and 20 by 30 for upper elementary grades and not less than 12 feet high in clear. Modification allowable only after consultation with the Board. Desks should be laid out on the preliminary plans. (See drawing.) The School Committee advise, and this Board has adopted, the policy of having a small portion of the rooms in a building, perhaps 10 or 20 per cent, of a size that will seat 50. Every class-room shall be consecutively numbered on the plans to designate it. These numbers to be for the doors, as noted below, and for the annunciator. Other rooms that appear on the annunciator to be named on the plans, as assembly hall, teachers' or master's room, cooking-room, manual training room. The kindergarten shall be counted as a class-room. In high schools both class and recitation rooms to be numbered, other rooms named.

(2.) *Windows* will be on the long side for left-hand lighting. The glass measured inside the sash shall contain not less than one-fifth of floor area, neither double run of sash nor double glazing nor weather strips will be required, the head square and close to the ceiling; the sill about 2 feet 6 inches from the floor where a gravity indirect system of heating is installed and 2 feet 11 inches where there is to be a plenum system; the

windows divided with muntins, no large sheets of glass. Finished with plastered jamb, no architrave, metal corner bead.

(3.) *Doors.*—One to corridor, 3 feet 6 inches by 7 feet, partly glazed, to open out, placed preferably near the teacher's end; (two doors may be desired under certain conditions); brass-plated steel butts, 4-level mortise lock; master keyed; cast brass knobs, marble flush thresholds to corridors for first-class construction. Doors to have 2-inch, plain brass numbers, and cardholders, 3½ inches by 5 inches, and hooks to hold open.

(4.) *Floors* will be maple.

(5.) *Walls* will be painted burlap up to top of blackboards, or of tack boards, and above this plaster tinted in water color,—a warm gray green or buff gives the best results,—the blackboards 4 feet high, 2 feet 2 inches from floor in kindergarten, 2 feet 4 inches to 2 feet 6 inches in Grade IV., and 2 feet 8 inches in Grade V. to VIII.; behind the teacher and on the long side. These will be of best black slate ¼ inch thick. At end, in place of blackboard, soft wood sheathing with burlap stretched over it with sewed seams for a tack board, to extend from the base to the moulding at top of blackboards, to have wood strips to cover tacks. In lower grades a card rack covered with burlap is required above the blackboard only. A picture moulding at top of burlap, and also near ceiling in all rooms. (See drawings.)

(6.) *Ceilings* will be level, plaster tinted a light cream color. Ceiling angles square.

(7.) *Lights.*—Nine chain pendant electric fixtures on three switches. No gas.

(8.) *Heating and Ventilation.*—The inlet for heat about 5 square feet, the outlet for ventilation about 5 square feet.

(9.) *Bookcase.*—Provide a bookcase in any convenient position, capable of containing 300 octavo volumes (600 volumes in bookcases for upper grades); upper doors fitted with pin tumbler locks, and latch and knob; drawers fitted with pin tumbler locks and small brass pulls. Lower doors to have pin tumbler locks; same lock in each bookcase; all bookcase locks

master keyed. (See drawing.) Special equipment for care of books where school is held day and evening is desired similar to that existing at the Charlestown High School, so that the books of the day pupils will be put away in pigeonholes, leaving the desks free for evening use.

(10.) *Teacher's Closet.*—Provide a small closet for teacher's coat and hat, preferably opening from the class-room, but allowable from the wardrobe, closet to have about 6 hooks and one shelf.

(11.) *Fittings.*—Bulletin board and letter box should be included in general contract.

FRESH-AIR ROOMS

The School Committee is responding to the more general demand for fresh-air rooms for children who are anæmic or of tubercular tendencies. At present all that the Board is advising to meet this new demand is that a sunny room, preferably a corner room, be chosen for this work, and that the windows on one or on two sides be made casement, to open out, or arranged as the Board may direct; and that the heat be largely direct, so that the temperature can be quickly raised, if necessary, when the windows are closed. Otherwise these rooms will be the same as other class-rooms.

WARDROBES

(*a.*) (1.) *Side.*—Wardrobes will adjoin school-room and be from 4 feet 6 inches to 5 feet wide.

(2 and 3.) *Windows and Doors.*—Outside light, two doors, both connecting with school-room, and not to corridor, and having no thresholds. Doors, double swung, 2 feet 6 inches wide, brass double-acting butts, foot and hand plates, hooks or adjustable stops to hold open, ventilation under door farthest from vent.

(4.) *Floors.*—Terrazzo or composition with border and base for first-class construction. For second-class construction, to have composition floor and base. For all cases, to have a drip gutter for umbrellas.

(5.) *Walls.*—Painted burlap to a height of 7 feet, poles on brass-plated iron brackets with hooks under and pins over, 44 in number; umbrella clips and drip gutter below. (See drawing.) Walls above, plaster, tinted. Height of lower pole, kindergarten 30 inches from floor; lower grades, 36 inches to 40 inches; upper grades, 44 inches, 48 inches and 52 inches; distance between poles, 8 inches for elementary, 12 inches for high schools. Pins and hooks, 8 inches to 12 inches on centers for elementary and 16 inches to 18 inches for high. Each hook to have a painted number 1¼ inches high. An individual compartment is desired for each pupil. The Commissioners are experimenting along this line at present.

(6.) *Ceiling.*—Plaster, untinted.

(7.) *Light.*—One lamp. Ceiling outlets, electric. Switch in class-room.

(8.) *Heating and Ventilation.*—Heating, direct. Ventilation, vent duct, 1 2-3 square feet area cross section.

CORRIDORS AND VESTIBULES

(1.) *Size.*—Not less than 8 feet wide for four rooms on a floor; not less than 10 feet for over four rooms, governed by length, access to stairs, etc.

(2.) *Windows.*—Outside light essential.

(3.) *Doors.*—Main outer doors to open out, heavy butts, standard, master keyed, school lock; lock set to be furnished by the Department but set by the Contractor; door check; heavy hooks to hold open. Vestibule doors open out, heavy butts, pulls, push plates, hooks to hold open, door checks, no locks. Outer doors to basement open out, and fitted with standard latch lock. Other hardware as above.

(4.) *Floors.*—Terrazzo divided into areas not to exceed 80 square feet, by slate strips, and to have terrazzo or marble base for first-class construction. Wood floor and base second-class construction.

(5 and 6.) *Walls and Ceilings.*—A light glazed brick, untinted walls and ceilings. Put picture moulding at ceiling in corridors.

(7.) *Light.*—Ceiling or short pendant fixtures (electric), 32 candle power each, also gas for emergency in corridors, on stairs, and in vestibules.

(8.) *Heating and Ventilation.*—Heat direct, supplemented by foot warmers on first floor. Ventilation where possible.

(9.) *Sinks and Closets.*—On each floor above the first, one or two 4-foot sinks, with 2 fountains.

STAIRCASES

(1.) *Number and Arrangement.*—Determined by the Board, and not over 5 feet wide.

(2.) *Material.*—The treads, North River stone on iron string, or concrete construction with granolithic surface for first-class construction; wood for second-class construction. Rails of a simple pattern, easily cleaned; wall rails are desired.

(3.) *Steps.*—About 6½ or 7 inches by 10½ inches. Rail not less than 2 feet 8 inches on runs and 3 feet on landings.

(4.) *Exits.*—Exits from the lower landings of stairs are desired. These may have emergency bolts where so desired.

SANITARIES

(1.) *Size.*—General toilet-rooms in basement, in size approximating space for 1⅞ water-closets for each school-room, *i. e.*, ⅝ boys and 1¼ for girls, and 33 inches of urinal for every school-room, arranged for convenient supervision and circulation. Slate sinks, length from 10 inches per class-room in small buildings 6 inches per class-room in large buildings, located preferably in the play-rooms. The above refers to mixed schools.

(2.) *Windows.*—Ample outside light; glazed where exposed to view outside with ribbed glass; to have wire guards.

(3.) *Doors.*—The doors arranged "in" and "out," with spring or door check and stout brass hooks to hold open; glazed with ribbed glass; half doors to water-closets.

(4.) *Floors.*—Asphalt. Boys' drained to urinal, girls' to floor wash.

(5.) *Walls.*—Salt-glazed brick or other non-porus inexpensive surface, 7 feet high; above, brick painted.

(6.) *Ceiling.*—Untinted plaster or white-washed concrete. Basement ceiling need not be furred level for first-class construction. For second-class construction ceiling should be plastered.

(7.) *Light.*—Ceiling or short pendant electric fixtures.

(8.) *Heat and Ventilation.*—Heat direct. Ventilation through water-closets and space back of urinals, allow 10 square inches local vent for each water-closet and 8 square inches for each lineal foot of urinal.

PLUMBING FIXTURES

(1.) *Water-Closets.*—The pupils' water-closets for elementary schools are wash down closets; siphon action, upper classes, 16½ inches high; lower classes, 13½ inches high. Teachers' same with raised rear vent 16½ inches high. (See drawing.)

(2.) *Partitions.*—To be ⅞-inch V-grooved hard wood sheathing applied vertically, with top and bottom rails of same wood, supported at ends with iron pipe about 8 feet high, tied together and to the wall, to which doors are hung. Back partition of water-closets to be wood sheathing over a 2-foot slate base. Finish of wood (color) to match that of rest of building. (See drawing.)

(3.) *Urinals.*—The urinals will be of slate, floor slab, trough and back, with partitions where requested, flushed automatically from special tank, through ⅞-inch perforated pipe, with cold water; vented at bottom into space behind. (See drawing.)

(4.) *Sinks* of black slate, two self-closing cocks, and jet drinking fountains, set 20 inches on centres. A sink is desired for electrician unless there is one near by.

(5.) *Floor Washes* in sanitaries and play-rooms as already mentioned. (See drawing.)

(6.) *Piping.*—(*a.*) Cast iron must be laid on good footing in basement, clean-outs at every change of direction,

Soils and vents exposed as far as possible, no asphaltum, red lead and three coats of paint.

(*b.*) *Supplies.*—Exposed as far as possible; where covered may be plain brass, elsewhere polished brass; no nickel plate. Hot water for janitor's use in basement, cooking-room, and for master's and teachers' room. Supply from boiler and from summer boiler, if any, or from an independent hot water heater. No auxiliary supply wanted for water-closet tanks.

(c.) *Fire Lines.*—In buildings over three stories high, one or more lines of 3-inch pipe if requested by the Board.

PLAY-ROOMS

All free basement space to be arranged as play-rooms for boys and girls. Salt-glazed brick, 7 feet high, and painted or whitewashed brick or stone walls above. Granolithic floors, plaster ceilings or whitewashed concrete. Basement doors and windows to have wire guards in channel iron frames; guards to be hinged and padlocked. Doors are desired from the play-rooms to the play-yards. Areas at doors are not desired.

MASTER'S AND TEACHERS' ROOMS

(1.) In each school of the upper grades a room of about 240 square feet for the master, with a water-closet and bowl and a book-closet adjoining. This room should be near the centre of the building, *i. e.*, on the second floor, in a three-story building. In all schools a room or rooms for teachers, averaging about 300 square feet for ten teachers, with one water-closet and bowl. Doors to be clearly marked "Master" or "Teachers" in brass letters and one water-closet and bowl on each floor of six rooms for teachers' emergency.

(2.) Where men as well as women are teachers, a separate room with toilet accommodations for men.

(3.) Opportunity in teachers' rooms for warming luncheon, either gas or electric.

SPECIAL ROOMS

ASSEMBLY HALLS

Assembly halls should accommodate from 400 to 800. It is not considered necessary to seat the full number of pupils in schools of greater capacity. The floor to be level and of wood like class-rooms, or linoleum. The windows to be fitted with rebated mouldings to take black shades, and so designed as to make the operation of shades practical and simple. The platform should be capable of accommodating one, or, in the large schools, two classes, and should have removable stepped platforms of wood to take the benches. Galleries may be used where the hall is two stories in height. Ante-rooms near the platform are desirable, and a connection from adjoining class-rooms to the ante-rooms or directly to the platform. A dignified architectural treatment of the walls and a studied color scheme for walls and ceiling is expected. The lighting, acoustics and exits should be such as belong to a small lecture hall. Artificial lighting to be under control from at least two points, one of which must be near an exit. Electric outlet for 30-ampere projection lantern, 25 feet from curtain. Provide recess in ceiling over platform for spring-rolled curtain 13 feet long. For assembly hall an allowance in cubing is made by the Board of two class-rooms for schools of medium size, that is, about sixteen class-rooms, and four class-rooms for schools of larger size, *i. e.*, over twenty-four class-rooms to represent the added area for this purpose.

MANUAL TRAINING ROOMS

(1.) *Size.*—Room, generally located in basement, if floor can be above grading, should be approximately 900-1,000 square feet, preferably a corner room, and the larger of the two allowed sizes of rooms, and arrangement shown by drawing, for number of benches there given, 25. In elementary schools for boys only 22 benches are sufficient.

(2.) *Light.*—The windows should be as near full length as possible and on two sides. Artificial light in chain pendant electric fixtures, one light to every four benches.

(3.) *Floors.*—Of wood.

(4.) *Walls.*—A basement room should be finished as a shop; salt-glazed brick up to 7 feet where exposed, and above blackboard brick walls whitewashed. If above basement, finished as a class-room.

(5.) *Ceilings.*—Like basement.

(6.) *Heating and Ventilation.*—The same as in class-rooms. If in basement provide some direct radiation.

(7.) *Fittings.*—(*a.*) *Stock-room.*—Stock-room should contain at least 80 square feet, preferably long and narrow. Eighteen-inch shelves should run around the room, 5 feet 6 inches and 6 feet 6 inches from the floor.

(*b.*) *Wardrobes.*—Wall space for 26 double coat and hat hooks, in a separate room.

(*c.*) *Teachers' Closets.*—Teachers' closet should be small for personal belongings, with shelving and hooks under.

(*d.*) *Store-room.*—For finished work and hardware should be fitted with all shelving possible; an area 40 square feet is adequate.

(*e.*) *Bookcases.*—Like those in class-rooms, 150 capacity.

(*f.*) *Work-rack.*—About 28 feet long, made in sections, 6 feet 6 inches high and 2 feet deep. The length is to take 24 compartments (equaling the number of benches) and the height the number of divisions that use the room (two each day, five days, outside limit). Compartments to have numbers and letters painted. (For all of these, see drawings.)

(*g.*) *Sink.*—A 3-foot soapstone sink, with hot and cold water, with drinking fountain if desired.

(*h.*) *Display Frames.*—Four display frames, size and position as indicated, of burlap over soft wood back, with 2-inch moulding around.

(*i.*) *Demonstration Steps.*—Demonstration steps are desired.

(*j.*) *Furniture.*—(Not included in the building contract.) The furniture comprises 25 benches and stools, teachers' desk,

table 4 feet by $2\frac{1}{2}$ feet, with unfinished top, 1 desk chair and 2 common chairs, a clock. (See drawing.) Lay these out on preliminary drawings. Lower benches to be set toward the front and nearer the windows.

(*k.*) *Blackboards.*—Provide about 15 running feet of slate blackboards, 4 feet high.

(*l.*) *Glue Pot.*—Provide electric or gas connections for same.

COOKING ROOM

(1.) *Size.*—Should have an area of 900-1,000 square feet, preferably a corner room on top floor, but generally in basement, and the larger of the two allowed sizes of room, and arranged for 24 stations.

(2.) *Light.*—Windows as in a class-room, if located in a corner, from two sides. Artificial light as in a class-room.

(3.) *Walls.*—Above basement, similar to school-rooms, blackboards, 4 by 10 feet, back of teacher's desk. Walls painted in oils. A basement room may have salt-glazed brick walls up to 7 feet and painted brick above. (See drawings.)

(4.) *Floors.*—The floor to be wood or linoleum, on cement, except space occupied by ranges, which is tiled.

(5.) *Ceilings.*—Ceilings like basement, or, if above basement, like class-rooms.

(6.) *Heat and Ventilation.*—Less heat is required than in a class-room, but the ventilation should be the same, with additional vent from the demonstration ranges. Hoods over ranges if Board so desires.

(7.) *Fittings.*—(*a.*) *Wardrobes.*—Provision for 24 pupils, double coat and hat hooks in separate lighted closet, and teachers' small closet.

(*b.*) *Work Benches*, accommodating 24 pupils, fitted with compartment for utensils, bread-board, etc., a Bunsen burner with a hinged iron grille over it, set on aluminum plate at each station; benches arranged in the form of ellipse, or oblong, with access to centre from two sides; top of pine 24 inches wide; open underneath and supported on pipe standards. One section de-

tached and fitted as a demonstration bench; a clear space of 4 feet all around. Dining table (furnished under another contract) is to be set in centre. (See drawings.) Lay these out on preliminary drawings and include in final drawings and contract.

(*c*.) *Dresser.*—Ten feet long, in 3 sections, 4 adjustable shelves and glazed sliding, or hinged doors at top; one set of 3 drawers and 2 cupboards on lower part. A shelf should be put in each cupboard about 12 inches from top.

(*d*.) *Fuel-box.*—In 2 compartments, each about 24 inches square and 30 inches deep, with hinged lids; small shelf in one section. Accommodations in the main coal-room for a supply of range coal and kindling wood.

(*e*.) *Bookcase.*—Similar to those provided in class-rooms.

(*f*.) *Sink.*—Soapstone, 4 feet long; 2 cold and 2 hot water cocks; soapstone drip shelves 24 inches long, at each end of sink, provided with grease trap. Sink should be near ranges.

(*g*.) *Hot Water Supply.*—(See instructions in plumbing.)

(*h*.) *Coal and Gas Ranges.*—A six-hole coal range and a similar gas range, with hood provided, and set on a hearth previously mentioned.

(*i*.) *Refrigerator.*—Will be a part of the furniture. Furnished under another contract.

SEWING ROOM

The following is a list of standard equipment adopted by the School Committee.

(Not to be included in the general contract for building.)

30 Portable tables (inserted yard measure).*
50 Chairs in girls' school*
and
30 In mixed schools, varying in height from 14 inches to 21 inches from floor.*
1 Glass show case about 8 feet long, 2½ feet or 3 feet wide.
1 Cutting table, 8 feet long, 3 feet wide and 2 feet 6 inches high, inserted yard measure, 3 drawers in table, blackboards, minimum of 30 square feet.
Closet for teachers' wraps.

Stationary washbowl with running hot and cold water.
1 7½-lb. electric iron.
14-lb. electric iron.
Standard box rack with box for each girl. (See drawing.)
1 Sewing machine for 500 or fewer girls.
* Not required when no regular "sewing room" is available.

KINDERGARTEN

(1.) *Size.*—The rooms can be contained in the space of a class-room and wardrobe, but a slightly larger area, 800 to 900 square feet, is desirable, and preferably the larger of the two allowed sizes of room. They comprise a large room, a small room, a supply closet, a wardrobe and a water-closet. The large room should take a 16-foot circle, regulation lines painted on the floor with at least 4 feet all around it. (See drawing.) The small room, about 200 square feet.

(2.) *Light.*—Windows should be as in a class-room, if on a corner, on both sides. Exposure should be sunny. Artificial light of the class-room type arranged for the different rooms.

(3.) *Doors.*—Door to corridor as in class-rooms. Wide doors should open from small room into large room.

(4.) *Floors.*—Wood or linoleum cemented onto concrete surface, with painted lines as above.

(5.) *Walls.*—As in class-rooms, with blackboard as in lower grades.

(6.) *Ceilings.*—As in class-rooms.

(7.) *Heat and Ventilation.*—As in class-rooms.

(8.) *Fittings.* (*a.*) *Wardrobe.*—Hooks for 60, arranged as in ordinary wardrobes.

(*b.*) *Teachers' Closet.*—For clothing of two or three teachers.

(*c.*) *Toilet-room.*—Immediately adjoining with low-down seat and bowl or sink.

d.) *Bookcase.*—As in lower grades.

NURSE'S ROOM

(1.) *Size.*—From 200 to 400 square feet, according to size of school.

(2.) *Windows.*—Outside light as in class-rooms.

(3.) *Shades.*—Set to roll from windowsill upward. Not in building contract.

(4.) *Doors.*—One door to corridor, as in class-room, marked "Nurse's room."

(5.) *Walls.*—Upper two-thirds plaster, smooth finish, round corners, painted with light green oil paint. Lower one-third to floor, glazed white tile with sanitary base.

(6.) *Floor.*—Terrazzo, like corridors for first-class construction. Composition for second-class.

(7.) *Heat and Ventilation.*—As in class-rooms.

(8.) *Light.*—Pendant electrolier with special shade. Extra socket on body of fixture for hand portable.

(9.) *Nurse's Closet for Supplies.*—Size, 3 by 4; one shelf; 6 hooks for clothing.

(10.) *Bath Tub.*—Five-foot porcelain enameled iron, hot and cold water, where requested by Superintendent of Nurses.

(11.) *Bowl.*—Enameled iron, hot and cold water faucets with shampoo cock. Hot water must be available all the year.

(12.) *Stove and Clock.*—Gas or electric heater as in teachers' rooms, and a secondary clock.

(13.) *Fittings.*—(Not in building contract.) (*a.*) *Cabinet.*—Oak finish medical cabinet, adopted as standard by Schoolhouse Commission. (*b.*) *Stool.*—White enamel revolving stool. (*c.*) *Table.*—Dressing table, white enamel frame, glass top and shelf; size, 16 to 20, rubber crutch tips. (*d.*) *Filing Case for Nurse's Records.*—Oak finish, to hold 1,000 cards, 4 by 6; lock and key; guide cards. (*e.*) *Writing Table.*—Oak finish, with drawer and lock; size, 20 by 30. (*f.*) *Chair.*—Oak to match table. (*g.*) *Couch.*—Flat frame oak, canvas adjustable top. (*h.*) *Mirror.*—Size, 2½ by 3, set over bowl.

HIGH SCHOOLS

CLASS-ROOMS AND RECITATION-ROOMS

High school class-rooms are laid out for classes of thirty-six or forty-two, generally the latter. A room 26 feet by 32 feet will accommodate forty-two high school desks. The larger class-rooms are to accommodate from sixty to eighty pupils; the larger number can be accommodated in a room 33 feet 8 inches by 43 feet. Recitation-rooms, which to a certain extent will be used also as class-rooms, should be about 16 by 26. These rooms, if equipped with continuous desks and seats as in a lecture-room, or with double desks, such as are to be used in the Charlestown High, would accommodate about thirty pupils each. Lay out desks in one room of each type on preliminary plans.

ASSEMBLY HALL

For a high school would not differ materially from that already described for elementary schools.

MASTER'S AND TEACHERS' ROOMS

For accommodation of the principal there should be an outer office, that is, a waiting-room or reception-room, and an inner office, and rooms for both men and women teachers, which might well be concentrated in the neighborhood of the reception-room and the principal's room.

CHEMISTRY

The Rooms in General Required.—Laboratory, separate from lecture-room, may be used as recitation-room, but better to use lecture-room and keep laboratory free from desks and demonstration table. Lecture-room, separate from laboratory, but easy of access, may be used for recitation; in that case should have facilities for demonstration. Combined lecture-room for physics and chemistry admissible. Three rooms for administrative purposes, store-room for dry chemicals and apparatus, room for storage of liquid chemicals and preparation of reagents, which may also be used as a teacher's laboratory and an office. The

total area of the laboratory and administration rooms should be about 1,200 square feet and of the lecture-room about 600 square feet.

CHEMICAL LABORATORY

(1.) *Size.*—Should accommodate a class of forty to fifty pupils, with apparatus. Accommodation for three such classes.

(2.) *Light.*—On two sides.

(3.) *Heating and Ventilation.*—On same basis as for class-rooms, but removal of gases should also be provided for by a hood, each compartment of which should be ventilated by 9-inch hole at top, venting into elbow or T of drain pipe, thence connected by drain pipe into main flue, in which should be a fan operated by a motor.

(4.) *Walls and Ceiling.*—Walls of brick ideal, but not generally feasible, except on outside walls; plaster walls painted in oils and ceiling of plaster, covered with water-resisting surface containing no lead. All woodwork to have natural finish, except tops of desks.

(5.) *Floor.*—Preferably of concrete; may be of hard-wood in narrow strips, filled in by asphalt; should slope very slightly between desks, interspaces again trending to common corner, which may be drained.

(6.) *Equipment.*—Working desks at right angles to greater length of room, in sections back to back between windows; sections movable when top is removed. Each section 21 feet to 24 feet 6 inches long, 2 feet wide, 3 feet to 3 feet 2 inches in height. Distance between double sections about 5 feet, same distance at least between ends of sections and hood, which should be opposite longer line of windows and at right angles to direction of desk sections. Other ends of sections near enough to wall to allow for drain at right angles to sections and under windows. Desks to be of ash or any durable wood, natural finish. Top of narrow pine strips, treated with aniline black and waterproof lead finish. Individual desks provided with 3 lockers and 3 sets of drawers each, each set of drawers operated

by bar from locker, combination lock to fasten locker. Each double section of desks provided with soapstone sink, placed between sections and flush with section top, which should slope slightly to sink.* Sink 8 inches wide at least, and should begin within 1 foot of the end, toward hood, depth here to be 6 inches, running nearly to other end, where depth should be 8 inches. Each pupil to have working space of 3 feet 6 inches by 1 foot 8 inches. Each double section of desks provided with shelf for reagents, running length of desk, 10 inches to 12 inches above desk, supported by metal standards at suitable intervals, of white wood, 1¼ inches thick, 9 inches wide, natural finish, covered with glass plates, ¼ inch thick, 9 inches wide, suitable lengths, clamped to wooden shelf with as few clamps as possible. Wooden shelf at free end of each section, 1 inch to 1½ inches thick, 3 feet to 4 feet long, not over 1 foot 3 inches wide, height of 2 feet 8 inches to 2 feet 10 inches, for holding blast lamps, reagent jars, etc. Finish off top of shelf in aniline black. Floor space under second row of windows taken up with line of extra desks, built like sections, furnished in similar way, but without necessarily a drain to be used for emergency or general utility. Wall space not otherwise occupied may be used for shelves or cabinets. Fixed slate blackboards at end opposite second set of windows and parallel to desk sections, sliding slate blackboards above hood. Liquid waste may be thrown into desk sink, dry waste into earthen jars. Hood should run at right angles to desk sections and along wall opposite free ends of sections. In the construction of hood, protection against fire should be considered. Should be built against brick wall. Floor of hoods to be of slate; wood, inside and outside, to be finished natural. Space divided into three or four compartments, closed by sliding windows. Space against wall not occupied by hood for general link.

(7.) *Gas.*—Lead from gas main at free end of centre of double desk sections, branch into two leads along back of each

* Individual sinks are preferred by the teachers, although the long trough is apparently adequate for teaching elementary chemistry, and is less expensive.

section. Take-offs between each working desk space in form of pillar with two ¼-inch cocks, at each end desk a single cock. Two ¼-inch gas nipples at each side of each compartment of hood. Cocks of these outside of hood. Wall desk fitted with single gas taps at intervals of two feet.

(8.) *Water.*—Lead from water main at free end of centre of double desk sections. Size, large enough to fill section sink rapidly. Lead of ordinary size along length of section underside of shelf, take-off at free end of section, to which blast and suction pump may be attached. At junction of each four working desk spaces take-off, carrying two valves with hose bibb delivery ¼-inch, the two valves or cocks facing opposite sides. Suction pump attached to these bibbs if desired.

(9.) *Drains.*—Section desk sink to have open drain and mercury arrester, into which should be set movable concave netting of wide mesh to arrest larger solid matter. Main desk drain at right angles to sections along and under windows, between windows and sections should be in form of wooden trough, in sections dovetailed from 6 inches to 8 inches inside diameter and equally deep, covered with asphalt paint or filling; may be supported on brackets against wall and left open, or covered and provided with movable top. Into this drain will drip the lead pipes coming from section sink. Slate floor of each hood compartment should deepen slightly in centre, where there should be a hole 1 inch in diameter, into which is fitted short lead drain pipe, closed by perforated plug; drain pipes to be connected with sloping drain pipe, open or closed, running toward and delivering into general sink.

(10.) *Electricity.*—Current of electricity on section desks need not exceed ten volts, may be supplied from source common to physical and chemical side. Plugs between each working space placed under desk top on frame.

LECTURE AND RECITATION-ROOM

(1.) *Size.*—Area to depend on number of seatings required or number of pupils in classes; should be large enough

for two classes and should occupy a position between the laboratories for physics and chemistry.

(2.) *Light.*—As much glass area as class-room, preferably from left. Fit windows and other openings admitting light with dark curtains as specified under Assembly Hall. Electric lighting from top, controlled at point convenient to demonstration table.

(3.) *Floor* stepped up in fireproof construction and finished in wood, like floor.

(4.) *Heating and Ventilation.*—As for class-rooms, with extra ventilation to remove fumes. Space at left end of desk provided with register and flue of at least 10 inches diameter, to afford means of down draught. Flue carried under floor to nearest wall, flue and draught actuated by motor if not sufficient.

(5.) *Equipment.*—Demonstration table, not less than 12 feet long, not more than 3 feet nor less than 30 inches wide, height 32 inches. Placed 4 feet distant from wall, material same as that of room, top made of pine plank and finished like chemical laboratory desks. Pneumatic sink at right hand of desk, of soapstone in two depths. Not to exceed 30 inches long, 20 inches wide. Depth, 4 inches to 6 inches minimum; 16 inches to 18 inches maximum. Length of minimum depth not to exceed 60 per cent of total length. Sink to be depressed in table and provided with flush cover. Sink to have screened drain with mercury trap and overflow. Supply hot and cold water under reduced pressure and cold water under street pressure for quick filling, 2 goosenecks with ¾-inch hose bibbs, to one of which combined blast and suction pump may be attached; steam supply direct from boiler main with a by-pass to summer boiler; supply gas air suction, and gas taps not exceeding 6 in number. Over demonstration table, secured to ceiling, provide a plank with heavy screw hooks. Behind lecture table provide sliding blackboards of not less than 50 square feet, and a canvas curtain on heavy spring roller for attaching charts. Drawers and closets for lesser lecture apparatus and chemicals in body of table, wall on either side provided with shelves for reagent

bottles under glass, and side wall provided with cabinets for larger pieces of permanent apparatus, if there is no special room for this. Lifting seats with desk for taking notes arranged on platforms, so that the successive tiers will rise one above the other to insure an unobstructed view of demonstration table. (See drawing.)

(6.) *Electricity.*—Provide three (3) forms of current, viz., one circuit for direct current at 110 volts, 30 amperes, and one circuit of 5 to 20 volts, 50 amperes, and one circuit for alternating current at 110 volts, 30 amperes. Regulating rheostat for the 5 to 20 volt direct current to be located conveniently to table. A 50-ampere ammeter and a 125-volt voltmeter, both with extra large illuminated dials, mounted on swing brackets in full view of class and instructor; suitable means for switching ammeter and voltmeter to either circuit. Terminate circuits in non-reversible push plug receptacles. A projection lantern and receptacles for same at end of table and at rear of room. Lantern screen on spring roller at side of room, width of screen usually 12 feet, but dependent on distance and lenses used.

ADMINISTRATIVE FACILITIES

(1.) *Apparatus Store-room.*—Should give ample space for storage of extra and reserve apparatus and original packages of stock chemicals. These should be kept in dust-proof cabinets with glass doors and in drawers.

(2.) *Preparation-room.*—This should adjoin the above. Primarily for storage of liquid chemicals in bulk and preparation of liquid reagents and storage of supply bottles, also fitted for teacher's laboratory. Should have wide centre table with gas in centre, working desks, with drawers and closets along two sides, also gas, water, sink, blast, suction, steam and electricity. Shelves along desks for storage of liquid chemicals, supply bottles and smaller reagent bottles. An adequate hood should be provided.

(3.) *Office and Balance Room.*—Adjoining store-room and preparation-room should be small room to contain desk, book shelves, table and a good grade balance.

(1.) *Size.*—In a space about 30 by 40 feet. A laboratory, apparatus-room and shop.

(2.) *Light.*—The same basis as for class-rooms, one wall having as direct a southern exposure as possible for *porte lumiere* studies. Artificial light as in a class-room. Dark curtains in addition to regular shades for darkening room. Windows and all openings admitting light fitted as specified under Assembly Halls (page 65).

(3.) *Heating and Ventilation.*—On same general basis as for class-rooms.

(4.) *Equipment.*—Small laboratory tables to accommodate two or four pupils at each, built of hard wood, white pine tops, fitted with 4 drawers, supports and adjustable crossbar. Wall tables around room on sides where there are windows, with one or two shallow drawers under, but not deep enough to interfere with comfort of pupil. Soapstone drip sinks with cold water to be provided at these tables, one to every six or eight pupils. Instructor's table, fitted with hot and cold water, Richards' pump, numerous cupboards and drawers of various depths and widths. Two-inch plank bolted to ceiling over this table, with space of 2 or 3 inches between plank and ceiling for attachment of pendulums and other apparatus. Provide electric outlet for stereopticon and screen for same.

(5.) *Furniture.*—Provide adjustable stools for all the tables and a sufficient number of tablet arm chairs to accommodate the entire division during demonstration exercises. Chairs to be placed in rectangle formed by pupils' tables and demonstration table. These are not in building contract, but to be laid out on preliminary plans.

(6.) *Electricity.*—One outlet for direct current at 110 volts E. M. F. and 30-ampere capacity. One outlet for direct current at low voltage with regulator conveniently located. One outlet for alternating current at 110 volts E. M. F. and 30-ampere capacity. One outlet for each kind of current at demonstration table, to be single pole push plugs instead of binding

posts. Series and multiple connections at each pupil's table. Switch in laboratory to cut out pupils' tables.

(7.) *Gas.*—Pupils' tables to be equipped with gas, 4 cocks to each table. Wall tables to be equipped with gas. Demonstration table to be provided with gas.

(8.) *Bulletin Board.*—25 to 50 square feet of bulletin board, covered with burlap, secured at edges, but not glued on like wall paper.

(9.) *Blackboards.*—As much blackboard space as possible. Sliding blackboards back of demonstration tables.

APPARATUS-ROOMS

(1.) *Size.*—One large or several small rooms, to open directly out of laboratory, and connected with lecture-room.

(2.) *Equipment.*—To be fitted with dust-tight cases with adjustable shelves and sliding glass doors, 7 feet high; cabinets of drawers of various widths and depths, mostly narrow and shallow. Some of these cases may be in the laboratory if there is sufficient wall space. A small sink and hood should be provided.

SHOP

A small shop is desirable, though not absolutely necessary. This should be equipped with work bench, power lathe, belted to motor generator, and shelving for tools and stock, and may be set up in apparatus-room.

BOTANICAL AND ZOOLOGICAL LABORATORY

(1.) *Size.*—In a space about 30 by 40 feet. Laboratory and apparatus-room.

(2.) *Light.*—Windows the same as for class-rooms, one wall with southern exposure. Artificial light as in class-rooms.

(3.) *Equipment.*—(*a*). Twenty-one pupils' tables, 54 inches by 24 inches by 30 inches high, each to accommodate two pupils, to have plate glass tops.

(*b*.) Soapstone sink, 72 inches by 30 inches, 10 inches deep, accessible on all sides. Supply with cold water, about 8 bibbs and 2 hose bibb cocks.

(*c.*) One aquarium, 30 inches long, 20 inches wide and 20 inches high, with supply, gooseneck cock with aspirator and standing waste.

(*d.*) Ice chest, 36 inches by 24 inches.

(*e.*) Cases built wherever practicable. Three sections to contain 42 pigeonholes, 3 inches by 3 inches by 8 inches, for storage of instruments. A liberal supply of cases to contain drawers and cupboards in lower compartment, and shelves above, for exhibition of specimens, storage of material, instruments, books, charts, etc.

(4.) *Furniture.*—Forty-two adjustable screw revolving chairs, not in building contract.

GYMNASIUM AND DRILL HALL

(1.) To be used in common for gymnasium exercises, athletic games and the drilling of the school cadets. On account of its size and for structural conditions to be generally located in the basement, with clear span of ceiling and combined height of basement and first story. Visitors' gallery generally provided at one end, entered from first floor.

(2.) *Size.*—The classes exercising in the gymnasium are from fifty to one hundred, and a suitable floor space for this number, as well as floor space for a full company of cadets at drill, is from 3,750 to 4,000 square feet. The height should not be less than 24 feet.

(3.) *Light.*—Ample outside light in all cases. Electric light from ceiling protected with wire guards.

(4.) *Heat and Ventilation.*—The former sufficient to guarantee a temperature of about 60 degrees, and about twice as much ventilation as is customary for the ordinary class-room. This is, of course, insufficient for the number of people who might occasionally occupy the gymnasium for exhibitions, but it is more than enough for the ordinary number using it for class exercises.

(5.) *Equipment.*—The standard gymnastic apparatus consists of the following fixtures, which may be slightly modified in particular cases:

25 Bar stalls.
25 Bar stall benches.
2 Double booms.
2 Saddles.
20 Vertical ropes.
2 Serpentine ladders.
2 Boxes, 1 horse.
12 Balance boards.
2 4 by 7 mats.
2 5 by 10 mats.
4 Pairs jumping standards and ropes.
2 Pairs basket ball goals.
3 Basket balls.
4 2½-lb. medicine balls.
16 2-lb. medicine balls.
4 Indoor baseballs and bats.
1 Fairbanks scale.
1 Water spirometer.
1 Tape measure.
1 Dozen glass mouthpieces.
24 Bean bags.
1 Truck to carry mats.
100 Pairs ¾-lb. Indian clubs.
2 Jump boards.
1 Shoulder caliper.
100 Solid rubber bounding balls, 2¼ in. diameter.
100 Pairs ¾-lb. dumb-bells.
100 Wands ¾-in. in diameter.

(6.) *Gun Racks.*—Racks for holding the guns carried by the cadets should be provided on walls. These racks should be protected by locked doors.

(7.) *Special Rooms.*—Adjoining gymnasium and drill hall two small rooms about 10 feet square should be provided for school matron and director of gymnasium.

(8.) *Dressing-rooms, Baths and Lockers.*—(*a.*) *System.*—The clothing of all the pupils is in a central locker-room, each suit being numbered, and all being under the control of the attendant in charge. Dressing-rooms are provided in number equivalent to the number of a class. A class coming for exercise are given their gymnasium clothing and keys to dressing-rooms, which they lock behind them when exercising. After

exercise they can take a shower bath. When dressed the dressing-room keys are given up, but the gymnasium clothing is left to be gathered up by the attendant. The clothing is carried to the dry-room, and when dried each set is put back in its proper pigeonhole.

(*b.*) *Lockers.*—The locker-room is controlled by the attendant, and contains pigeonholes, 10-inch cube, one for each pupil in the school, and a counter over which to deliver the clothing. Adjoining this is the dry-room, capable of being heated to a high temperature and thoroughly ventilated. This is fitted with hooks and clothesline.

(*c.*) *Dressing-rooms.*—The dressing-rooms are small cabins, about 3 feet square, with a locked door, a seat and hooks.

(*d.*) *Showers.*—The shower baths are 3 feet square, divided by slate partitions, similar to those for water-closets, each having a bar at the front, over which a cotton sheet can be dropped. Each compartment has two sprays in opposite corners.

MANUAL ARTS-ROOM

Rooms shall be provided for drawing, and in boys' schools for shop work in addition.

(1.) *Size.*—The space for each subject should be about 1,500 to 1,800 square feet.

(2.) *Light.*—Windows and artificial light by special fixtures. North light preferable in the drawing-rooms.

(3.) *Floors.*—Of wood.

(4.) *Walls.*—As in a manual training room.

(5.) *Ceilings.*—As in a manual training room.

(6.) *Heating and Ventilation.*—Same as in manual training rooms.

(7.) *Stock-room.*—The lumber stock-room should contain at least 80 square feet, and preferably be long and narrow. Shelves as directed.

(8.) *Teachers' Closets.*—As in manual training room.

(9.) *Fittings.*—(*a.*) Bookcases, like those in classrooms, 150 capacity.

(*b.*) *Cases.*—For work in process, extra tools, supplies, drawing boards, models, paper, finished drawings, etc. (For all of these get directions and see former High School drawings.)

ffl (*c.*) *Display Frames.*—Size and position as directed, to be of burlap over soft wood back with 2-inch moulding around.

(*d.*) *Sink.*—A 5-foot sink, with hot and cold water, fountains as directed.

(10.) *Equipment of Free-hand Drawing-room.*—Provide at least 25 oak drawing tables of approved type to be used by boys and girls in common.

(11.) *Equipment for Mechanical Drawing-room.*—(For boys only.) See Appendix XII. and former High School drawings.

(12.) *Equipment of Woodworking Rooms.*—(For boys only.) Provide at least 20 cabinet benches of approved type with quick action, iron vises. Provide glue pot with electric or gas connections as directed. Machinery if directed.

(13.) *Equipment of Metal-working Room.*—(For boys only.) Six double benches 8 feet by 2 feet, fitted with 12 Prentiss iron vises, $3\frac{1}{2}$-inch jaw; wall bench fitted with 10 stations, tool drawers and 5 Bower's tool holders; one $\frac{1}{4}$-inch gas hose cock terminal above each bench station; 2 gas blast burners, 1 large, 1 small; metal-covered bench with ventilated hood; 1 muffle furnace, ventilated; 1 drill; 1 grindstone; 1 pair bench shears. Machinery if directed.

(14.) *Motor.*—If directed.

(15.) *Blackboards.*—For each class-room for above subjects provide about 15 running feet of slate blackboard 4 feet high.

HOUSEHOLD SCIENCE

(1.) *Size.*—The space should be about 1,200 square feet, and should accommodate the kitchen, two small rooms for showing the care of a dining-room and of a bedroom, and a china closet and pantry.

(2.) *Light, Heat, etc.*—The same as that for other rooms, with additional ventilation in the kitchen.

(3.) *Equipment.*—The kitchen to contain an equipment as may be decided upon by the Board after consultation; a kitchen pantry fitted with shelving and a china closet fitted with a sink; drawers, cupboards and shelves enclosed with glass doors. The dining-room and bedroom simply finished rooms, having no equipment except the furniture.

LUNCH-ROOMS

(1.) *In General.*—The lunch-rooms in Boston schools have usually been located in the basement, and where these are high and well lighted this location seems to serve satisfactorily. They should, however, have the special ventilation that is provided in a basement cooking-room. In size they should accommodate comfortably, seated at benches or small tables, that proportion of the pupils in the school which takes advantage of the luncheon facilities.

(2.) *Equipment.*—(*a.*) The counter should be set at height as required, and should have a rail 2 feet from it, with openings at intervals, to keep children in single file, and there should be accommodation under the counter for dishes.

(*b.*) *Range.*—A six-hole gas range, with ample oven space.

(c.) *Sinks.*—Two good-sized soapstone sinks.

(*d.*) *Ice-box.*—Of sufficient size to take care of milk supply.

(e.) *Lockers.*—Sufficient to care for the clothing of the attendants, and for mops and brooms, etc. These should not be under the counter or near any place where food is kept.

(*f.*) *Furniture.*—In some cases the children are provided with camp chairs and small round tables to seat four. In others ordinary school benches have been provided. Both seem fairly satisfactory in operation.

LIBRARY

A space equivalent to a small class-room is ample for library purposes. The book accommodation will depend somewhat on the size of the school. The library is planned as a

reading-room, that is, with the books in the room and not in a separate stack-room.

WARDROBES

(1.) In high schools common wardrobes are—one for boys and one for girls—advised for all the clothing, situated on the lower floor to avoid bringing dirt into the upper floors. There being an attendant on the lower floor, the room, as a whole, can be locked up.

(2.) *Light.*—The rooms should have outside light.

(3.) *Heat and Ventilation.*—This should be thoroughly well heated and ventilated similar to class-rooms.

(4.) *Equipment.*—The poles, hooks, etc., will be similar to those used in other schools, but more space should be given the girls, *i. e.*, about 1 foot 6 inches on centre. It has been found desirable to have some locked pigeonholes, 20 by 20 by 12 inches.

ELECTRIC WORK

(1.) *Service.*—This should enter basement underground at location to be determined by reference to street mains, and should terminate on a switchboard located in a fireproof closet, opening if possible into the basement corridor.

(2.) *Conduits.*—All wires to be run in iron conduit concealed, except conduits for mains in basement, and side outlets in boiler, engine and stack-rooms. Tap circuit conduits to be run above rough floor wherever possible. If floor construction will not allow this, they are to be run below floor beams and above ceiling, a space of 2 inches being left in which they can be run.

(3.) *Wire Slot.*—Obtain from electrical division the location of slots and openings for conduits and panel boards.

(4.) *Cabinets.*—All cabinets to be furnished by wiring contractor, but finished by the general contractor.

(5.) *Cutting.*—All cutting and patching to be done by the general contractor.

(6.) *Outlets.*—Class-rooms to be provided with nine four-light ceiling outlets, controlled by three switches. Ward-

robes to have one ceiling outlet, controlled by switch in class-room. Corridors to be lighted from ceiling wherever possible. Height of side outlets in rooms and corridors to be 6 feet 6 inches. Switch outlets in class-rooms to be 6 feet, elsewhere 4 feet. Switches in corridors, play-rooms and pupils' toilet-rooms to be operated by private key. In lower elementary schools omit all electric lighting in class-rooms. Basement and corridor lighting to be installed as directed by the Board.

(7.) *Fixtures.*—Fixtures in class-rooms to be of special design to combine a direct and diffused light.

(8.) *Gas.*—Gas outlets to be provided in all corridors, vestibules, stairways, boiler-room and assembly hall exits; all to be wall outlets. Gas-piping to be included in the electrical engineer's work.

(9.) *Stereopticon.*—All grammar schools and high schools to be provided with an electric projection lantern with reflectoscope attachment.

(10.) *Clocks and Bells.*—All schools to be provided with an electric system of clocks, operated by a master clock. All primary schools to be provided with a system of signal bells, operated by push buttons. In all grammar and high schools the bell system to be operated automatically by master clocks, according to prearranged program.

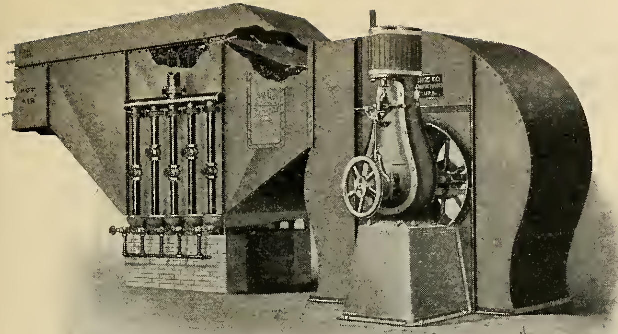
(11.) *Telephones.*—In all schools, each class-room, hall, teachers' room and boiler-room to be connected to master's office, or to room occupied by the first assistant, by a telephone system.

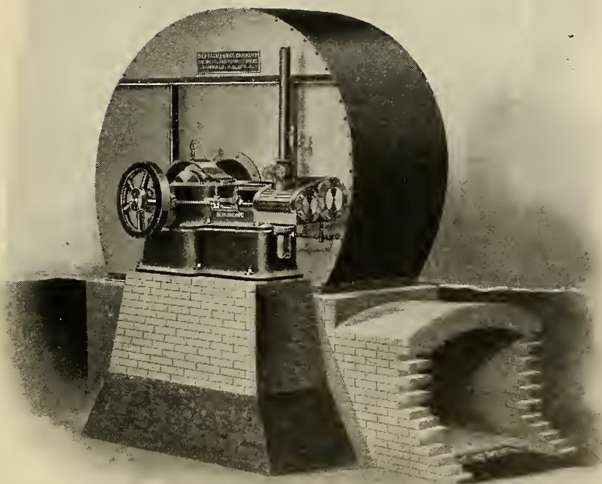
In lower elementary schools omit class-room telephones except in first assistant's room, boiler-room and one corridor.

NOTE.—Drawings showing special fittings for both plumbing and interior fittings will be found in Appendices XII., XIII. and XIV.

EQUIPMENT DETAILS

On the following twenty-one pages are illustrated various tested and standard equipment details for public schools. The Boston detail plates are reproduced by permission from the latest annual report of The Boston School House Commission, and represent the standard requirements of the city of Boston for several years past. The other details shown are in line with the latest and best practice elsewhere.





TWO ILLUSTRATIONS OF BLOWER SYSTEMS.

Courtesy of The American Blower Co., Detroit.

NOTE.—The fan or blower is contained in the circular shaped housing or casing. The upper illustration shows overhead delivery of hot air. The lower shows sub-basement floor ducts for the delivery of hot air.

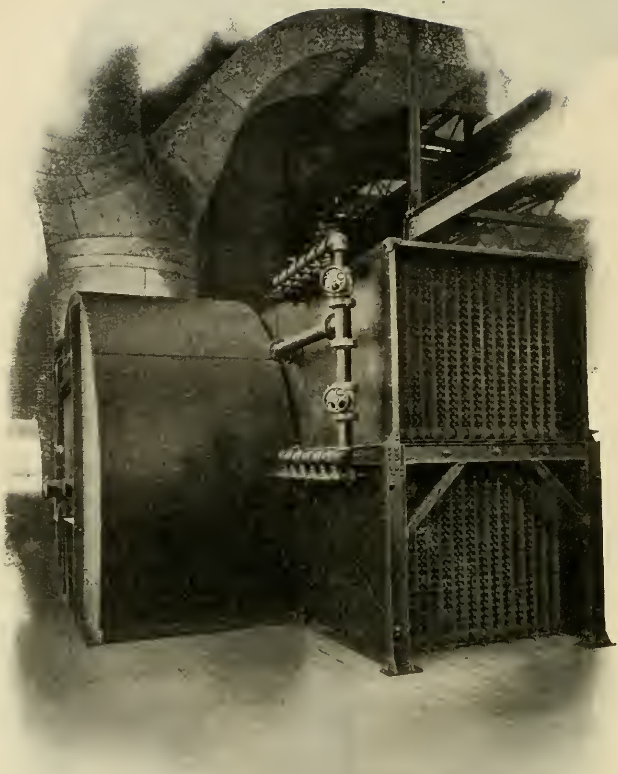
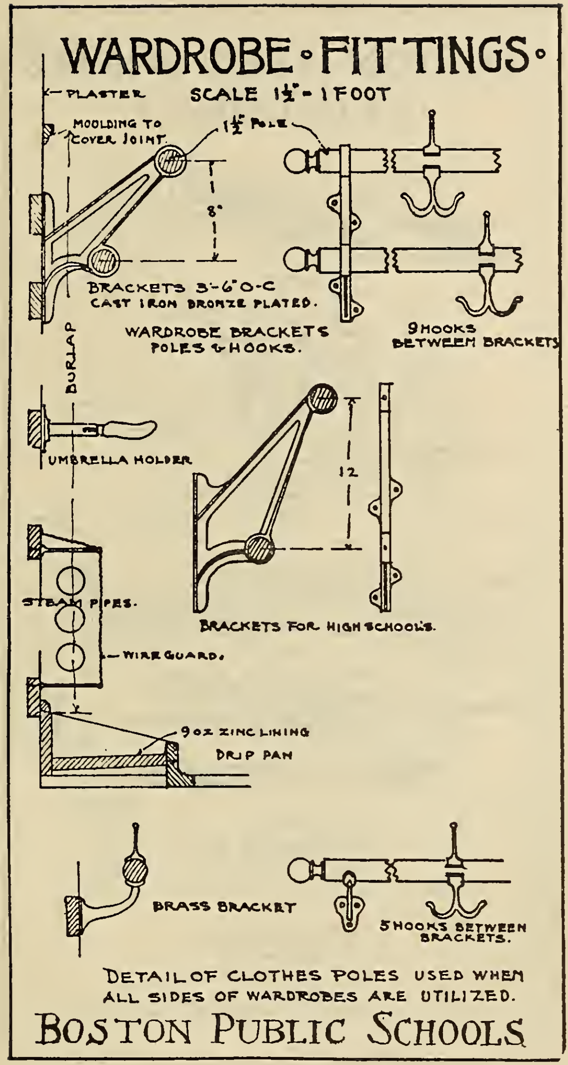
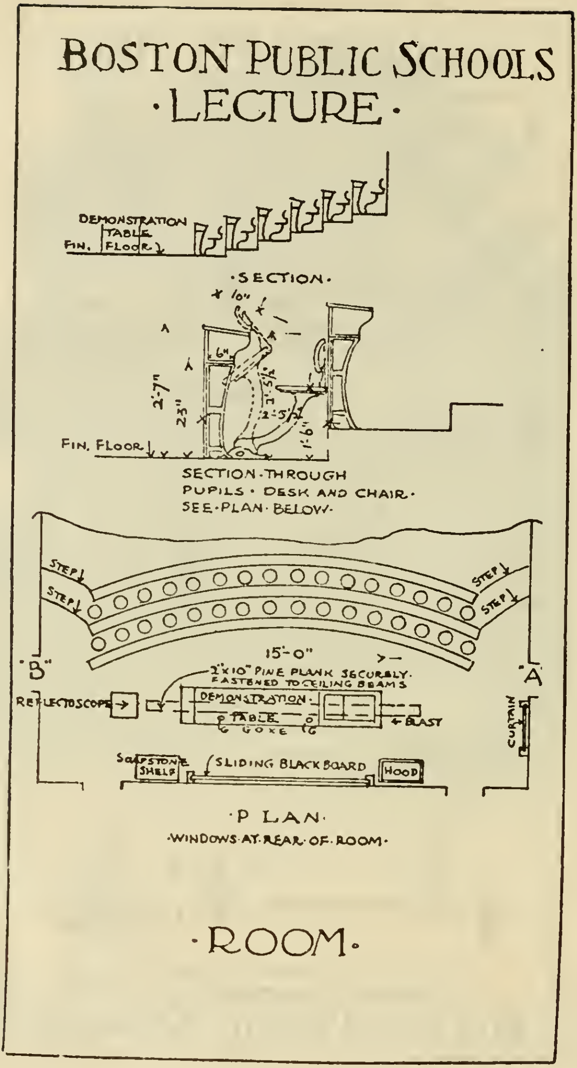


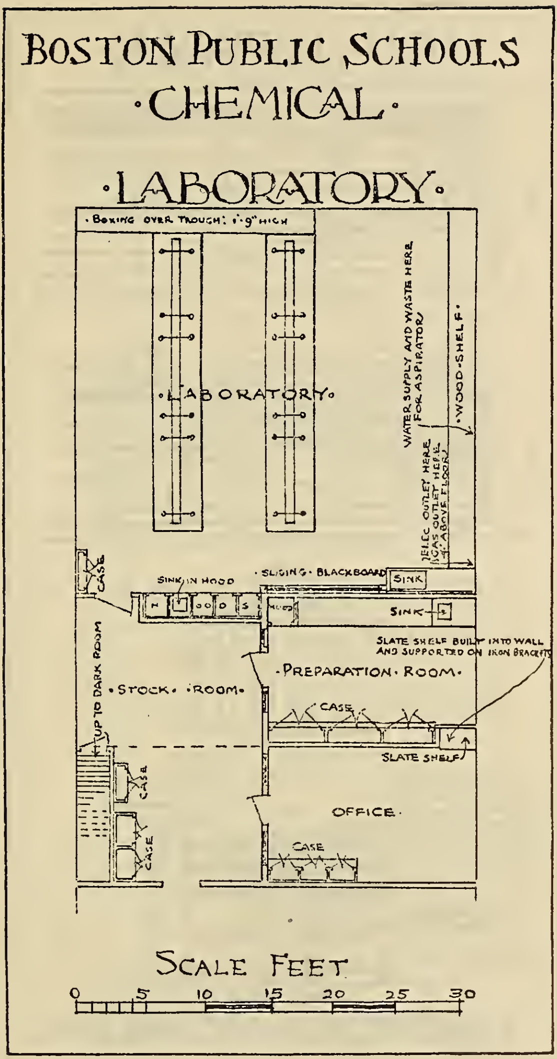
ILLUSTRATION OF MODERN BLOWER SYSTEM.

Courtesy of The American Radiator Co.

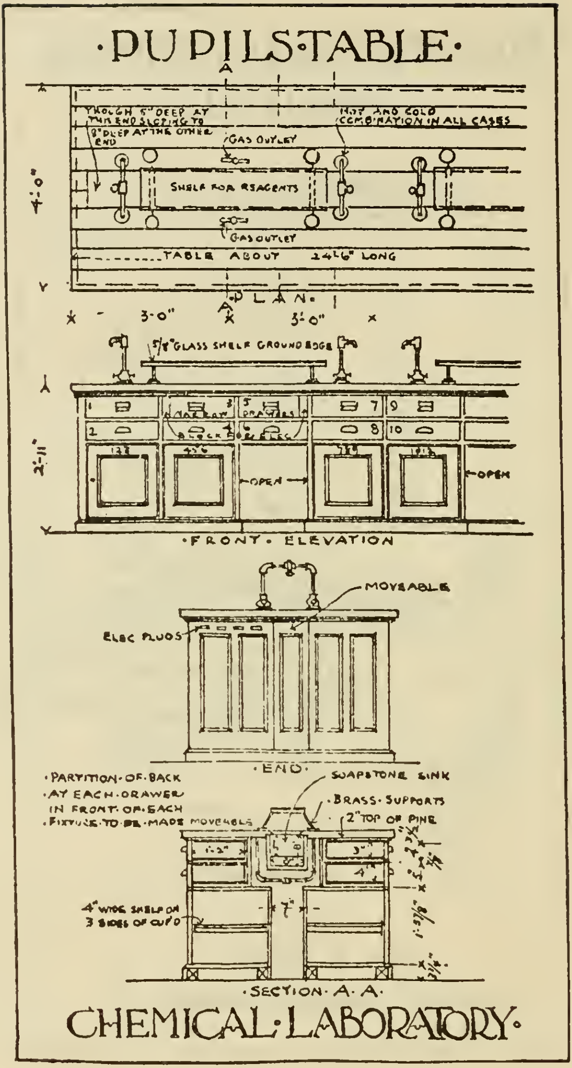
The large rectangular housing or boxes contain Hot "Vento" steam coils, and the curved housing contains the fan or blower. Cold air is drawn through the coils by the fan and forced thence out through the large ducts shown, into all parts of the building.

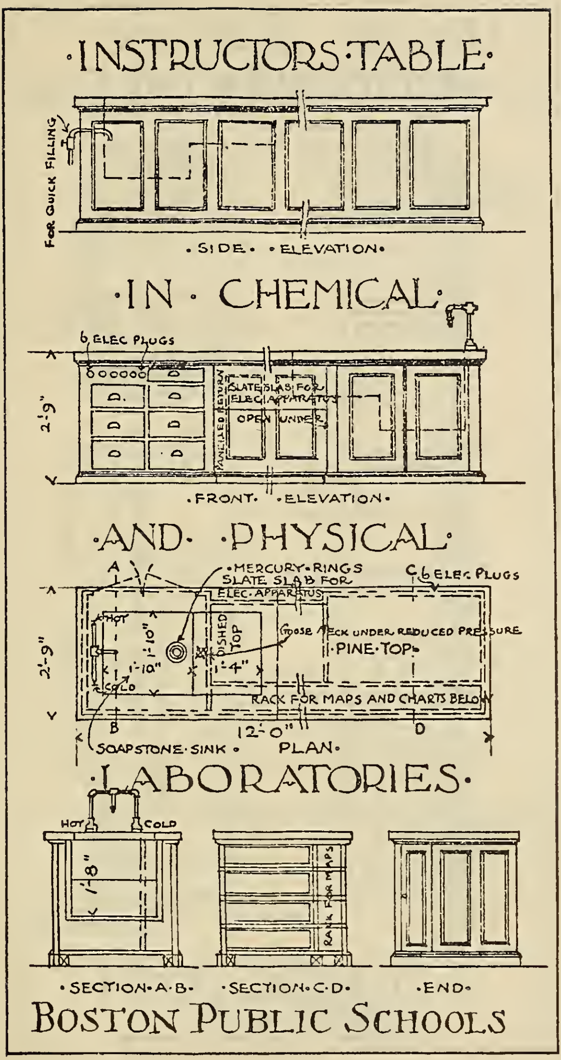

WARDROBE • FITTINGS •
SCALE 1½" = 1 FOOT
PLASTER
MOULDING TO COVER JOINT.
1½" POLE
8"
BRACKETS 3'-6" O-C
CAST IRON BRONZE PLATED.
WARDROBE BRACKETS POLES & HOOKS.
9 HOOKS BETWEEN BRACKETS
BURLAP
UMBRELLA HOLDER
12
STEAM PIPES.
WIRE GUARD.
BRACKETS FOR HIGH SCHOOLS.
9 oz ZINC LINING
DRIP PAN
BRASS BRACKET
5 HOOKS BETWEEN BRACKETS.
DETAIL OF CLOTHES POLES USED WHEN ALL SIDES OF WARDROBES ARE UTILIZED.
BOSTON PUBLIC SCHOOLS

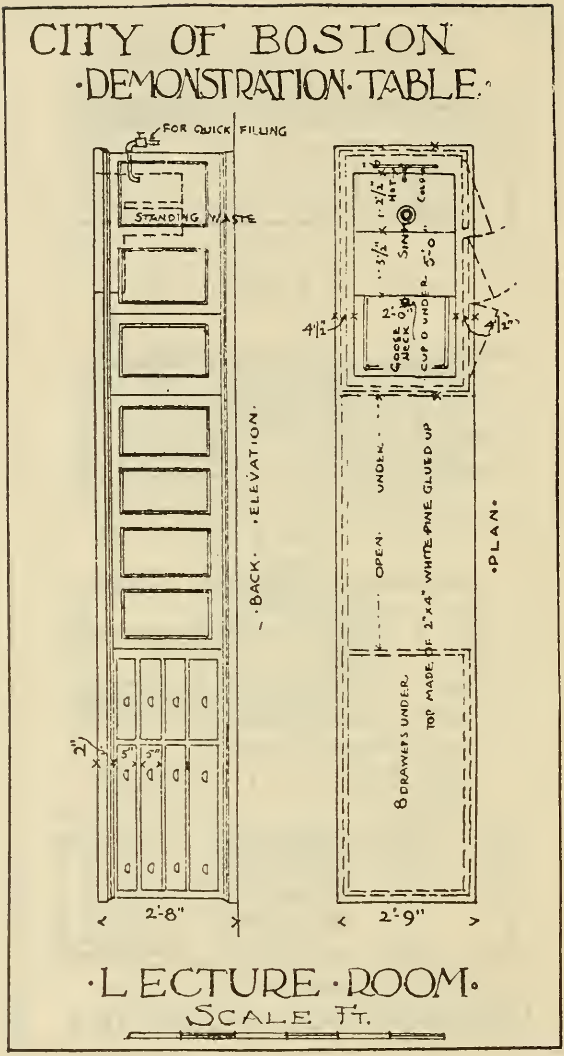

BOSTON PUBLIC SCHOOLS
· LECTURE ·
DEMONSTRATION TABLE
FIN. FLOOR
· SECTION ·
10"
6"
2'-7"
23"
2'-5½"
1'-6"
FIN. FLOOR
SECTION · THROUGH
PUPILS · DESK AND CHAIR ·
SEE · PLAN · BELOW ·
STEP
STEP
STEP
STEP
15'-0"
"B"
"A"
2"x10" PINE PLANK SECURELY FASTENED TO CEILING BEAMS
REFLECTOSCOPE
DEMONSTRATION TABLE
BLAST
CURTAIN
SOAPSTONE SHELF
SLIDING BLACKBOARD
HOOD
· PLAN ·
· WINDOWS · AT · REAR · OF · ROOM ·
· ROOM ·



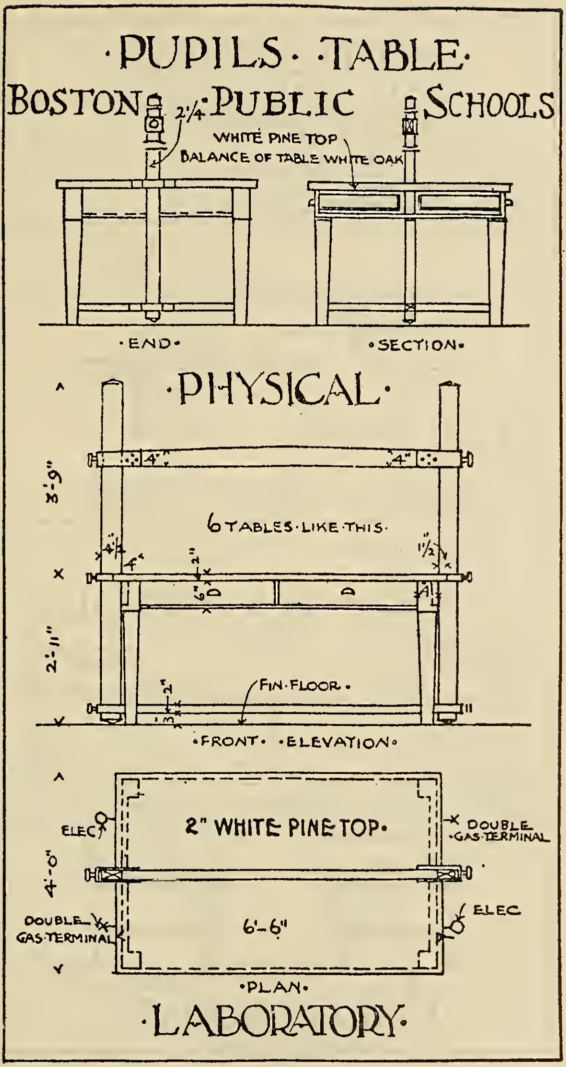
BOSTON PUBLIC SCHOOLS
·CHEMICAL·
·LABORATORY·
·BOXING OVER TROUGH: 1'-9" HIGH
·LABORATORY·
WATER SUPPLY AND WASTE HERE
FOR ASPIRATOR
·WOOD-SHELF·
ELEC OUTLET HERE
GAS OUTLET HERE
(4' ABOVE FLOOR)
CASE
SINK IN HOOD
·SLIDING·BLACKBOARD
SINK
SINK
SLATE SHELF BUILT INTO WALL
AND SUPPORTED ON IRON BRACKETS
·PREPARATION·ROOM·
UP TO DARK ROOM
·STOCK· ·ROOM·
CASE
SLATE SHELF
CASE
CASE
OFFICE·
CASE
SCALE FEET
0
5
10
15
20
25
30

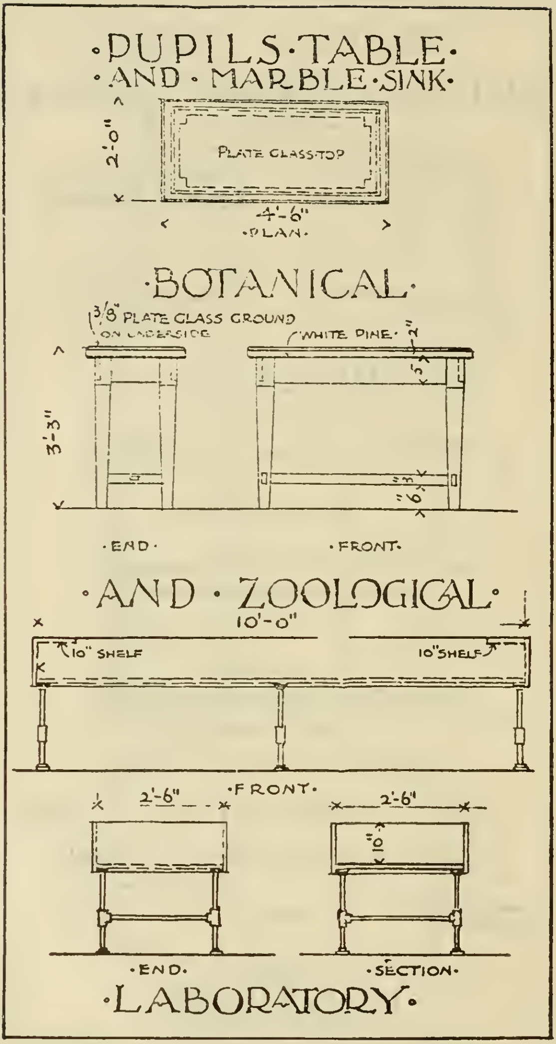

·PUPILS·TABLE·
GAS OUTLET
SHELF FOR REAGENTS
GAS OUTLET
TABLE ABOUT 24'-6" LONG
·PLAN·
3'-0"
3'-0"
4'-0"
5/8" GLASS SHELF GROUND EDGE
OPEN
OPEN
2'-11"
·FRONT· ELEVATION
MOVEABLE
ELEC PLUGS
·END·
·PARTITION·OF·BACK
·AT EACH·DRAWER
IN FRONT·OF·EACH
SOAPSTONE SINK
·BRASS·SUPPORTS
2" TOP OF PINE
4" WIDE SHELF ON
3 SIDES OF CUP'D
·SECTION·A·A·
CHEMICAL·LABORATORY·

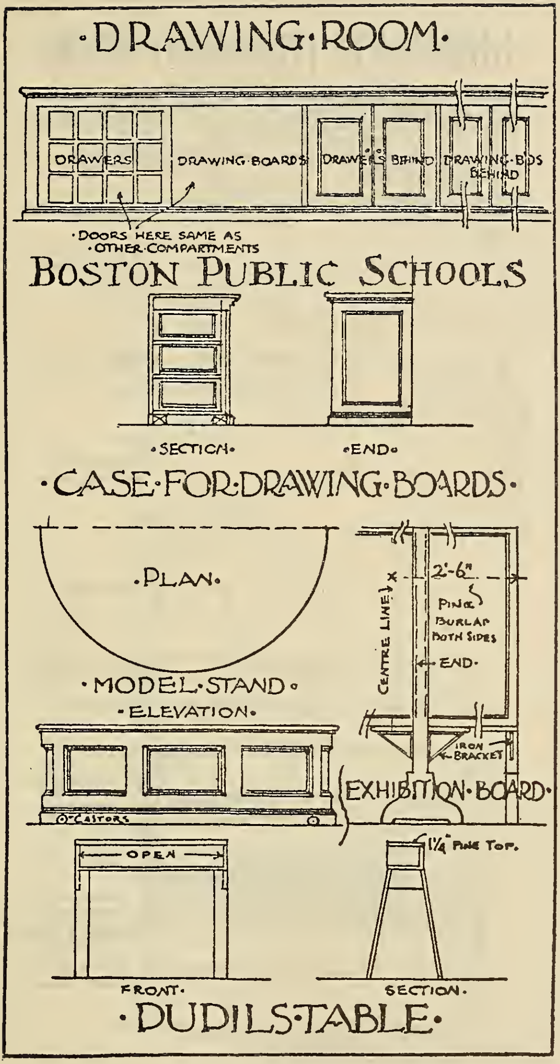

·INSTRUCTORS·TABLE·
FOR QUICK FILLING
·SIDE· ·ELEVATION·
·IN · CHEMICAL·
6 ELEC PLUGS
2'-9"
SLATE SLAB FOR ELEC APPARATUS
OPEN UNDER
PANELLED RETURN
·FRONT· ·ELEVATION·
·AND· ·PHYSICAL·
·MERCURY·RINGS
SLATE SLAB FOR
ELEC·APPARATUS
6 ELEC PLUGS
HOT
COLD
1'-10"
1'-10"
DISHED TOP
1'-4"
GOOSE NECK UNDER REDUCED PRESSURE
·PINE·TOP·
RACK FOR MAPS AND CHARTS BELOW
2'-9"
A
B
C
D
12'-0"
SOAPSTONE·SINK
PLAN·
·LABORATORIES·
HOT
COLD
1'-8"
RACK FOR MAPS
·SECTION·A·B·
·SECTION·C·D·
·END·
BOSTON PUBLIC SCHOOLS



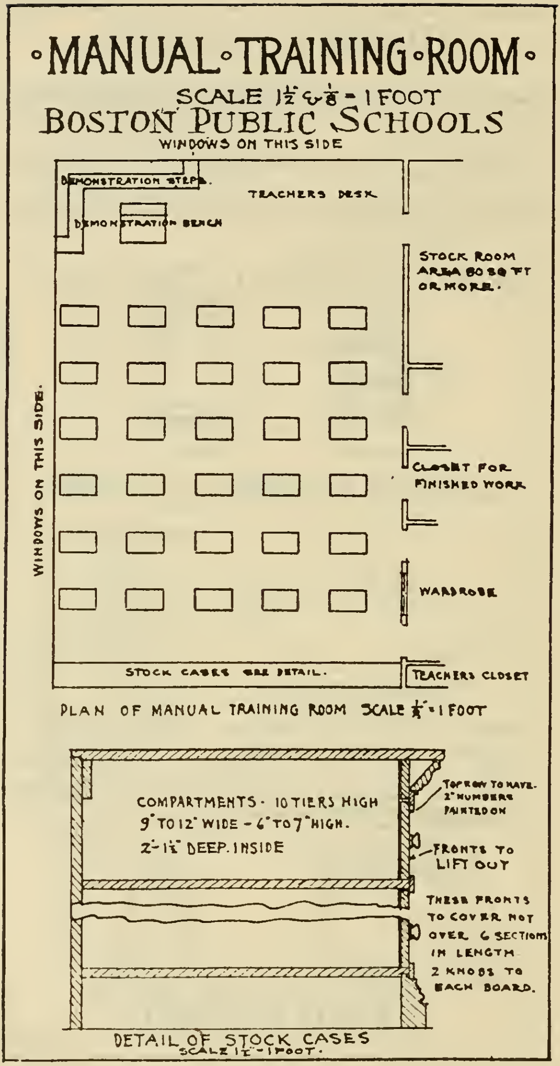
CITY OF BOSTON
·DEMONSTRATION·TABLE·
FOR QUICK FILLING
STANDING WASTE
·BACK· ·ELEVATION·
2"
5"
5"
2'-8"
HOT
COLD
SINK
GOOSE NECK
CUP O UNDER
OPEN UNDER
TOP MADE OF 2"x4" WHITE PINE GLUED UP
8 DRAWERS UNDER
·PLAN·
2'-9"
·LECTURE·ROOM·
SCALE FT.

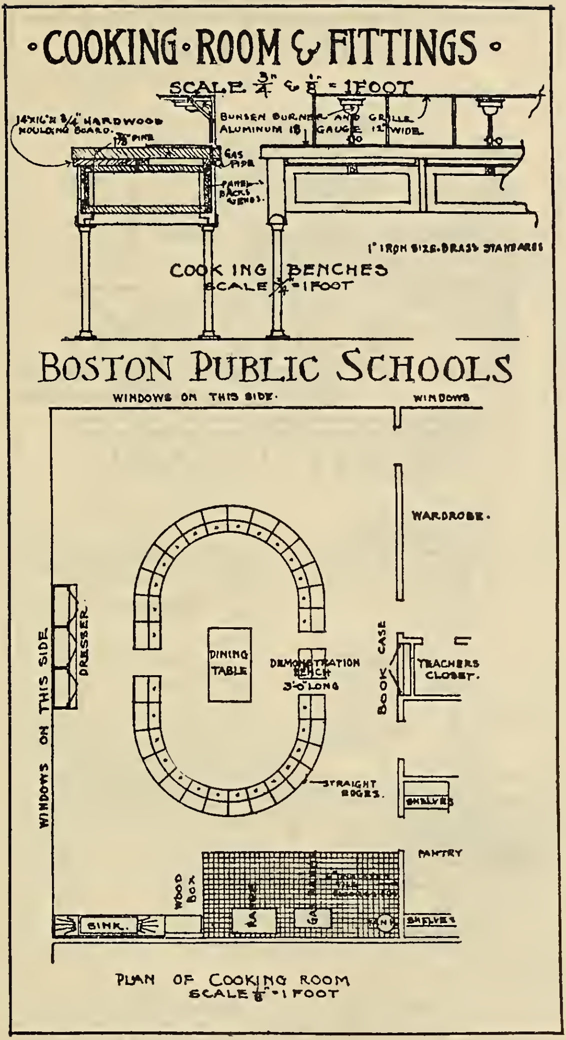

·PUPILS· ·TABLE·
BOSTON PUBLIC SCHOOLS
2¼"
WHITE PINE TOP
BALANCE OF TABLE WHITE OAK
·END·
·SECTION·
·PHYSICAL·
3'-9"
4"
6 TABLES·LIKE·THIS·
1½"
2'-11"
2"
6"
FIN·FLOOR·
·FRONT· ·ELEVATION·
ELEC
2" WHITE PINE TOP·
DOUBLE ·GAS·TERMINAL
4'-0"
DOUBLE GAS·TERMINAL
6'-6"
ELEC
·PLAN·
·LABORATORY·

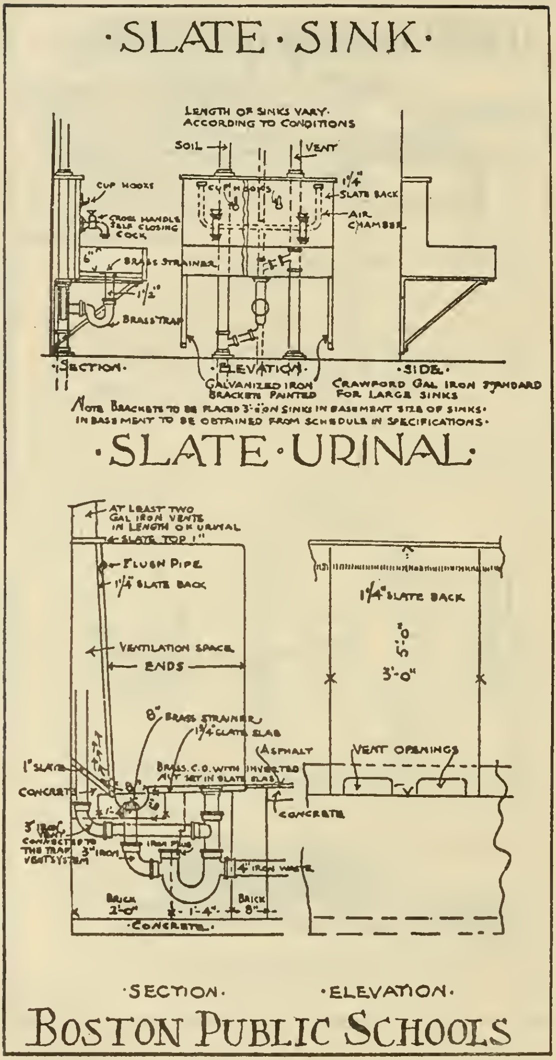

·PUPILS·TABLE·
·AND·MARBLE·SINK·
2'-0"
PLATE GLASS·TOP
4'-6"
·PLAN·
·BOTANICAL·
3/8" PLATE GLASS GROUND ON UNDERSIDE
WHITE PINE·
3'-3"
·END·
·FRONT·
·AND·ZOOLOGICAL·
10'-0"
10" SHELF
10" SHELF
·FRONT·
2'-6"
2'-6"
10"
·END·
·SECTION·
·LABORATORY·

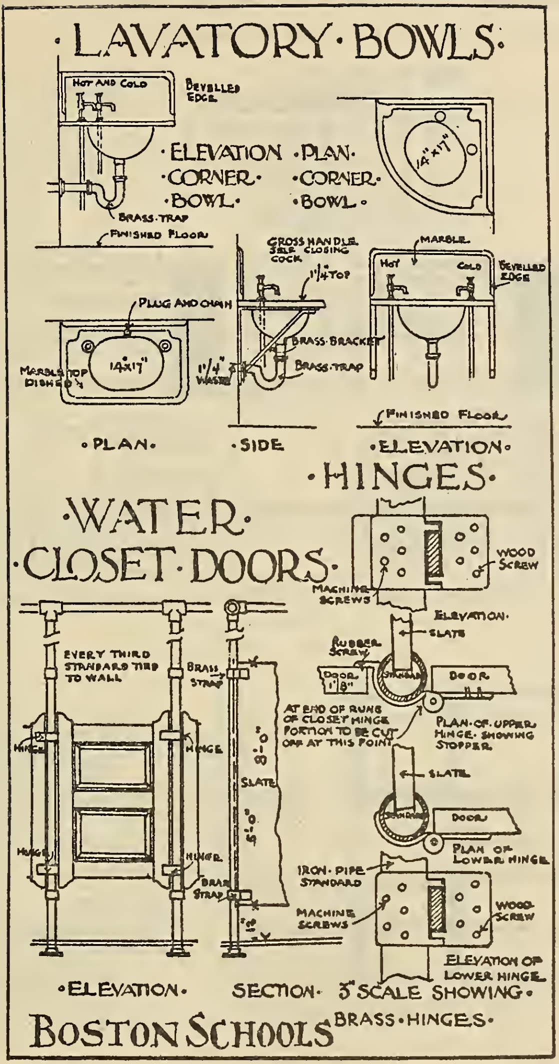


·DRAWING·ROOM·
DRAWERS
DRAWING·BOARDS
DRAWERS BEHIND
DRAWING·BDS BEHIND
·DOORS HERE SAME AS
·OTHER·COMPARTMENTS
BOSTON PUBLIC SCHOOLS
·SECTION·
·END·
·CASE·FOR·DRAWING·BOARDS·
·PLAN·
·MODEL·STAND·
·ELEVATION·
CASTORS
CENTRE LINE
2'-6"
PINE
BURLAP
BOTH SIDES
·END·
IRON BRACKET
·EXHIBITION·BOARD·
OPEN
1¼" PINE TOP.
FRONT·
SECTION·
·PUPILS·TABLE·

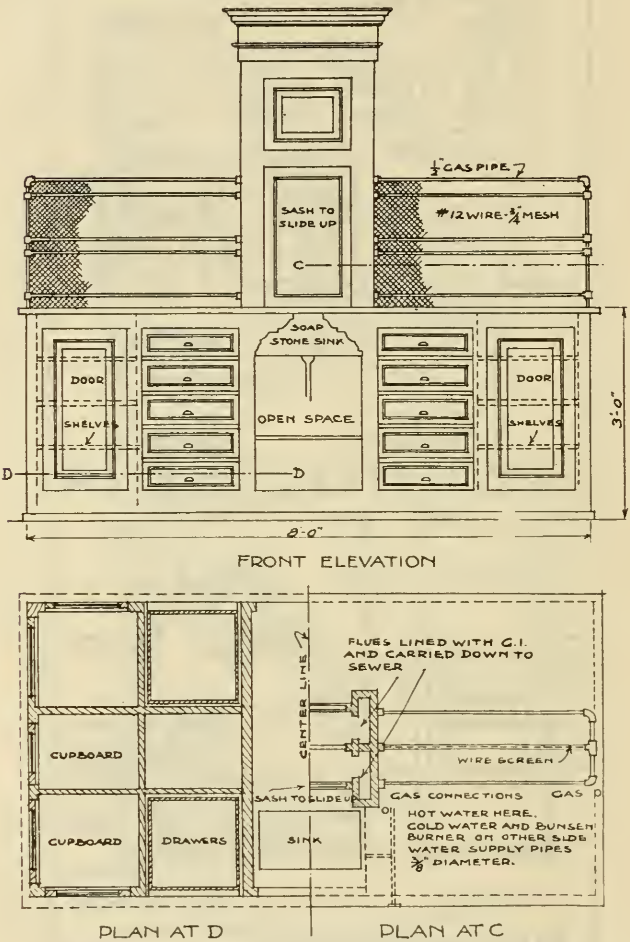

MANUAL TRAINING ROOM
SCALE 1½ & ⅛ = 1 FOOT
BOSTON PUBLIC SCHOOLS
WINDOWS ON THIS SIDE
DEMONSTRATION STEPS.
TEACHERS DESK
DEMONSTRATION BENCH
STOCK ROOM
AREA 80 SQ FT
OR MORE.
CLOSET FOR
FINISHED WORK
WARDROBE
WINDOWS ON THIS SIDE.
STOCK CASES SEE DETAIL.
TEACHERS CLOSET
PLAN OF MANUAL TRAINING ROOM SCALE ⅛" = 1 FOOT
COMPARTMENTS - 10 TIERS HIGH
9" TO 12" WIDE - 6" TO 7" HIGH.
2'-1½" DEEP. INSIDE
TOP ROW TO HAVE.
2" NUMBERS
PAINTED ON
FRONTS TO
LIFT OUT
THESE FRONTS
TO COVER NOT
OVER 6 SECTIONS
IN LENGTH
2 KNOBS TO
EACH BOARD.
DETAIL OF STOCK CASES
SCALE 1½" - 1 FOOT.


COOKING ROOM & FITTINGS
SCALE 3/4" & 1/8" = 1 FOOT
HARDWOOD MOULDING BOARD.
BUNSEN BURNER AND GRILLE
ALUMINUM 18 GAUGE 12" WIDE.
GAS PIPE
1" IRON SIZE BRASS STANDARDS
COOKING BENCHES
SCALE 3/4" = 1 FOOT
BOSTON PUBLIC SCHOOLS
WINDOWS ON THIS SIDE.
WINDOWS
WARDROBE.
WINDOWS ON THIS SIDE
DRESSER
DINING TABLE
DEMONSTRATION BENCH
3'-0" LONG
BOOK CASE
TEACHERS CLOSET.
STRAIGHT EDGES.
SHELVES
PANTRY
WOOD BOX
SINK.
SHELVES
PLAN OF COOKING ROOM
SCALE 1/8" = 1 FOOT

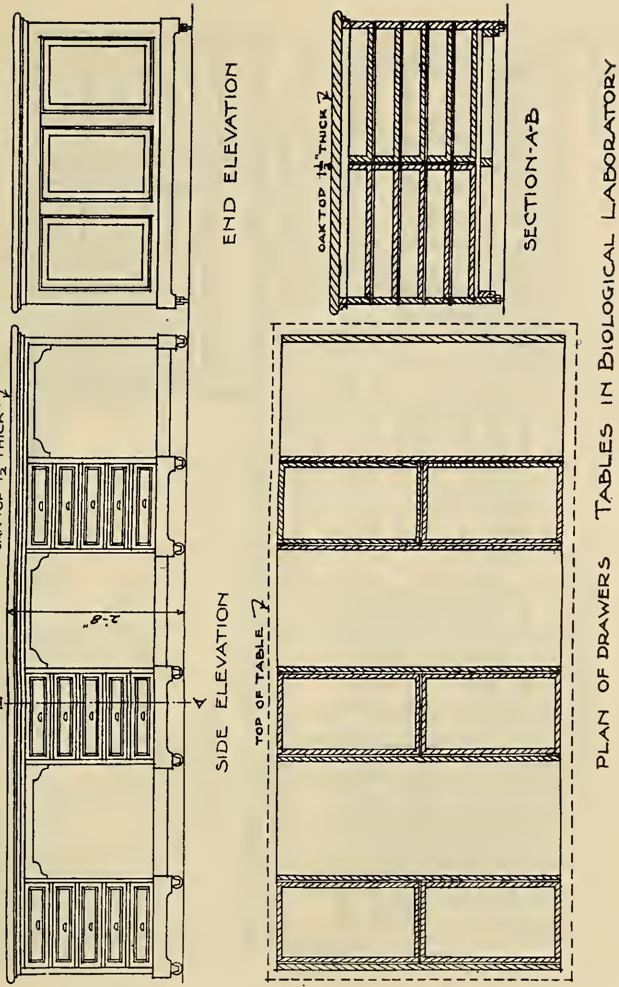

·SLATE·SINK·
LENGTH OF SINKS VARY·
ACCORDING TO CONDITIONS
SOIL
VENT
CUP HOOKS
1¼"
SLATE BACK
AIR CHAMBER
CROSS HANDLE SELF CLOSING COCK
6"
BRASS STRAINER
1½"
BRASS TRAP
·SECTION·
·ELEVATION·
·SIDE·
GALVANIZED IRON BRACKETS PAINTED
CRAWFORD GAL. IRON STANDARD FOR LARGE SINKS
NOTE BRACKETS TO BE PLACED 3'-0" ON SINKS IN BASEMENT SIZE OF SINKS·
IN BASEMENT TO BE OBTAINED FROM SCHEDULE IN SPECIFICATIONS·
·SLATE·URINAL·
AT LEAST TWO GAL IRON VENTS IN LENGTH OF URINAL
SLATE TOP 1"
FLUSH PIPE
1¼" SLATE BACK
VENTILATION SPACE
ENDS
8" BRASS STRAINER
1¾" SLATE SLAB
ASPHALT
VENT OPENINGS
1" SLATE
CONCRETE
BRASS C.O. WITH INVERTED ... SET IN SLATE SLAB
CONCRETE
3" IRON VENT CONNECTED TO THE TRAP VENT SYSTEM
3" IRON
IRON PLUG
4" IRON WASTE
BRICK 2'-0"
1'-4"
BRICK 8"
·CONCRETE·
1¼" SLATE BACK
5'-0"
3'-0"
·SECTION·
·ELEVATION·
BOSTON PUBLIC SCHOOLS

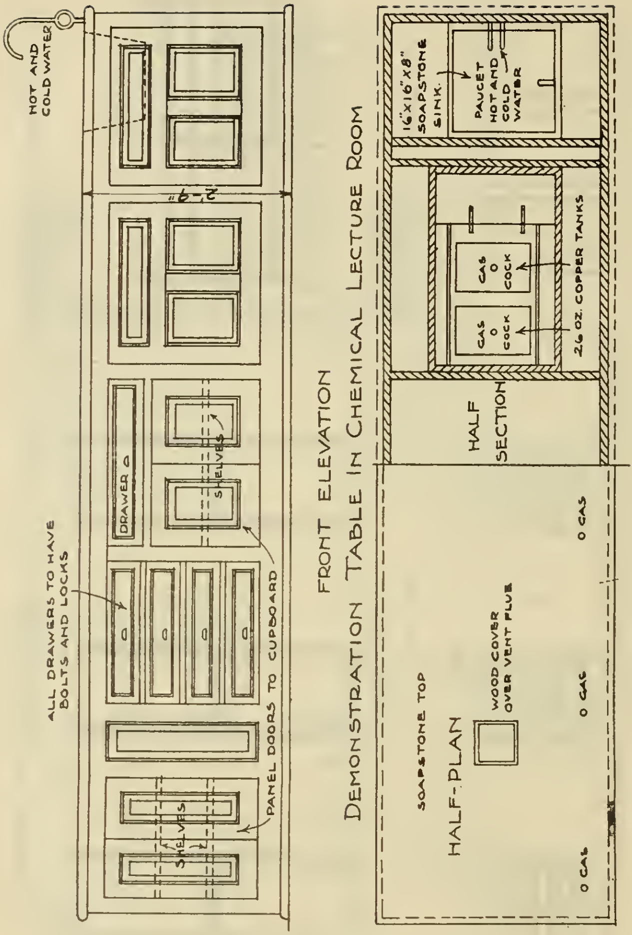

·LAVATORY·BOWLS·
HOT AND COLD
BEVELLED EDGE
·ELEVATION ·PLAN·
·CORNER· ·CORNER·
·BOWL· ·BOWL·
14"x17"
BRASS·TRAP
FINISHED FLOOR
CROSS HANDLE SELF CLOSING COCK
1¼" TOP
MARBLE
HOT
COLD
BEVELLED EDGE
PLUG AND CHAIN
BRASS·BRACKET
BRASS·TRAP
MARBLE TOP DISHED ½
14"x17"
1¼" WASTE
FINISHED FLOOR
·PLAN·
·SIDE
·ELEVATION·
·HINGES·
·WATER·
·CLOSET·DOORS·
WOOD SCREW
MACHINE SCREWS
ELEVATION·
SLATE
RUBBER SCREW
DOOR 1'8"
STANDARD
DOOR
EVERY THIRD STANDARD TIED TO WALL
BRASS STRAP
AT END OF RUNS OF CLOSET HINGE PORTION TO BE CUT OFF AT THIS POINT
PLAN·OF·UPPER HINGE·SHOWING STOPPER
HINGE
HINGE
SLATE
SLATE
DOOR
PLAN OF LOWER HINGE
HINGE
HINGE
IRON·PIPE STANDARD
BRASS STRAP
MACHINE SCREWS
WOOD SCREW
ELEVATION OF LOWER HINGE
·ELEVATION·
SECTION·
3" SCALE SHOWING·
BRASS·HINGES·
BOSTON SCHOOLS

NOTE: The illustrations on this and the next five pages are equipment details employed in the author's practice, and have been found complete and satisfactory.



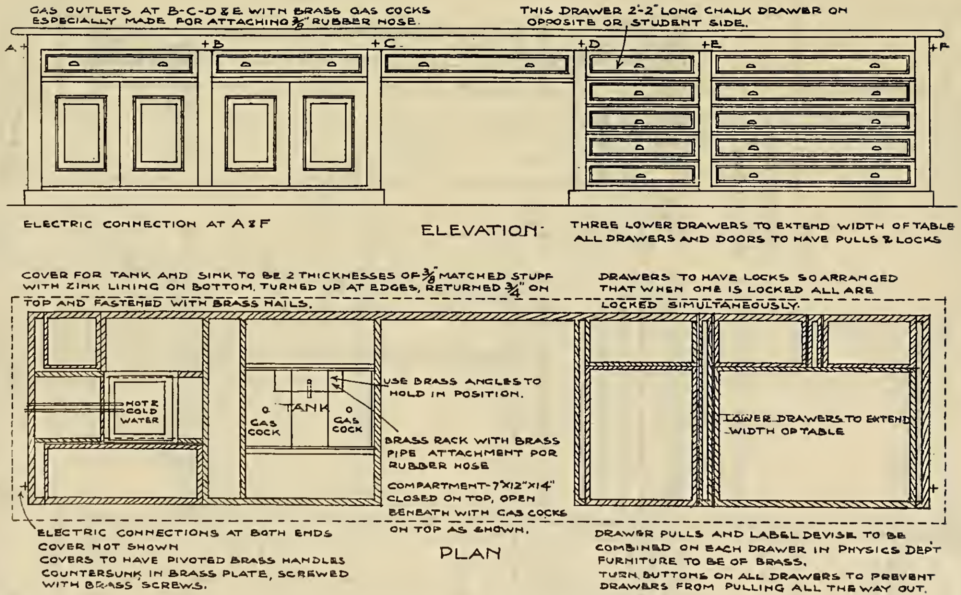
TABLES IN CHEMICAL LABORATORY


OAK TOP-1½" THICK
2'-8"
A
B
SIDE ELEVATION
END ELEVATION
OAK TOP 1½" THICK
SECTION-A-B
TOP OF TABLE
PLAN OF DRAWERS
TABLES IN BIOLOGICAL LABORATORY

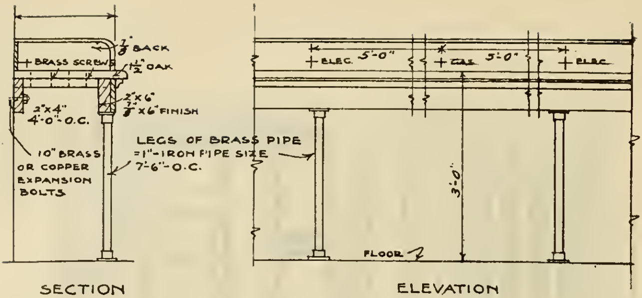


FRONT ELEVATION

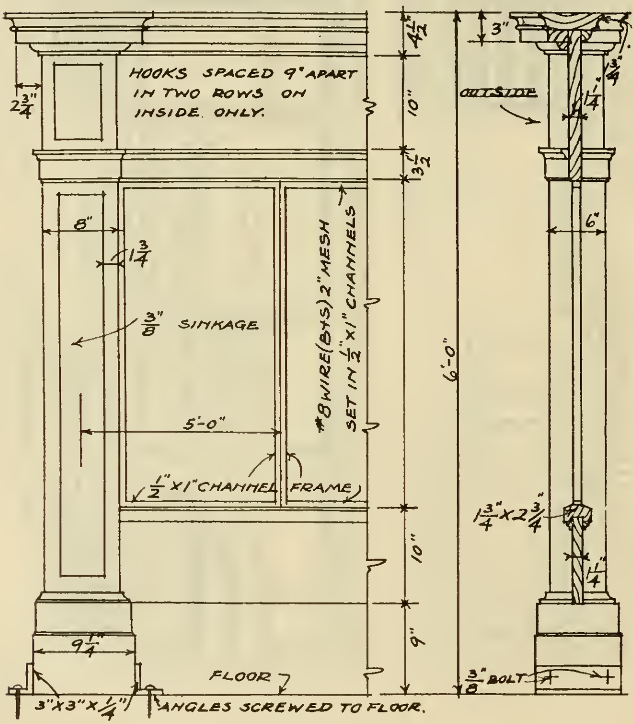
DEMONSTRATION TABLE IN CHEMICAL LECTURE ROOM



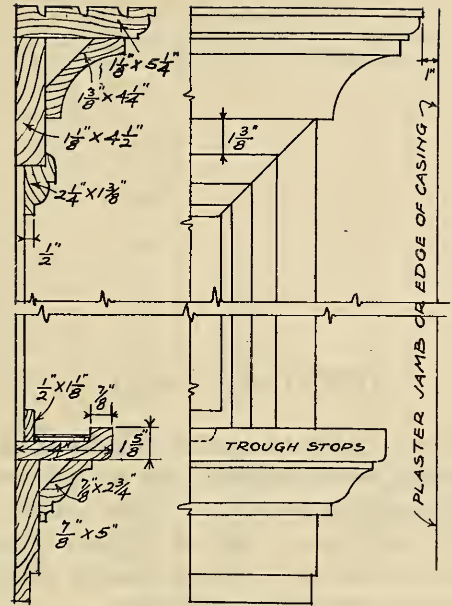
DEMONSTRATION TABLE IN PHYSICS LECTURE ROOM



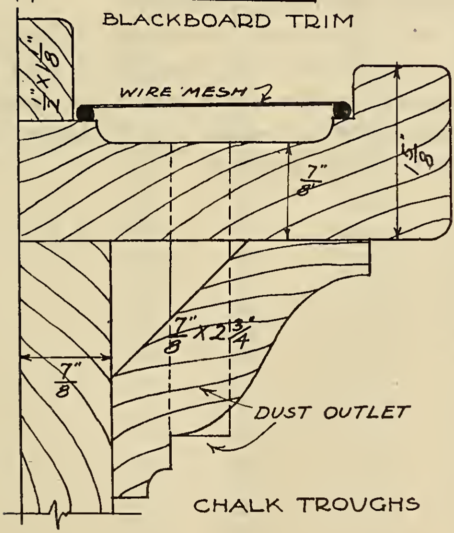
BENCH FOR PHYSICAL LABORATORY



COAT RACKS IN HALLS



BLACKBOARD TRIM



CHALK TROUGHS

REFERENCE TABLES

The following tables are supplied to facilitate the designer's work in planning school buildings, and not with any idea of covering the engineering needs of architects' offices. It is believed that the tables given cover all ordinary requirements in school house planning—up to the engineering stage—and including the simpler engineering problems.

By the use of these tables, the size of all flues, chimneys, heating and ventilating ducts, etc., may be obtained almost instantly, the required conditions being known; also nearly all other preliminary data needed in working out the heating and ventilating systems of school buildings.

DIAMETERS OF CIRCLES, CIRCUMFERENCES, AREAS, SQUARES, CUBES, SQUARE ROOTS AND CUBE ROOTS.						
No. or Diameter.	Circumference.	Circular Area.	Square.	Cube.	Square Root.	Cube Root.
1	3.1416	0.7854	1	1	1.000	1.000
2	6.2832	3.1416	4	8	1.414	1.259
3	9.4248	7.0686	9	27	1.732	1.442
4	12.57	12.57	16	64	2.000	1.587
5	15.71	19.63	25	125	2.236	1.709
6	18.85	28.27	36	216	2.449	1.817
7	21.99	38.48	49	343	2.645	1.912
8	25.13	50.27	64	512	2.828	2.000
9	28.27	63.62	81	729	3.000	2.080
10	31.42	78.54	100	1,000	3.162	2.154
11	34.56	95.03	121	1,331	3.316	2.223
12	37.70	113.10	144	1,728	3.464	2.289
13	40.84	132.73	169	2,197	3.605	2.351
14	43.98	153.94	196	2,744	3.741	2.410
15	47.12	176.71	225	3,375	3.872	2.466
16	50.26	201.06	256	4,096	4.000	2.519
17	53.41	226.98	289	4,913	4.123	2.571
18	56.55	254.47	324	5,832	4.242	2.620
19	59.69	283.53	361	6,859	4.358	2.668
20	62.83	314.16	400	8,000	4.472	2.714
21	65.97	346.36	441	9,261	4.582	2.758
22	69.11	380.13	484	10,648	4.690	2.802
23	72.26	415.48	529	12,167	4.795	2.843
24	75.40	452.39	576	13,824	4.898	2.884
25	78.54	490.87	625	15,625	5.000	2.924
26	81.68	530.93	676	17,576	5.099	2.962
27	84.82	572.56	729	19,683	5.196	3.000
28	87.96	615.75	784	21,952	5.291	3.036
29	91.11	660 52	841	24,389	5.385	3.072
30	94.25	706.86	900	27,000	5.477	3.107
31	97.39	754.77	961	29,791	5.567	3.141
32	100.53	804.25	1,024	32,768	5.656	3.174
33	103.67	855.30	1,089	35,937	5.744	3.207
34	106.81	907.92	1,156	39,304	5.830	3.239
35	109.96	962.11	1,225	42,875	5.916	3.271
36	113.10	1,017.88	1,296	46,656	6.000	3.301
37	116.24	1,075.21	1,369	50,653	6.082	3.332
38	119.38	1,134.11	1,444	54,872	6.164	3.361
39	122.52	1,194.59	1,521	59,319	6.244	3.391
40	125.66	1,256.64	1,600	64,000	6.326	3.419
42	131.95	1,385.44	1,764	74,088	6.480	3.476

DIAMETERS OF CIRCLES, CIRCUMFERENCES, AREAS, SQUARES, CUBES, SQUARE ROOTS AND CUBE ROOTS.—(Continued.)

No. or Diameter.	Circumference.	Circular Area.	Square.	Cube.	Square Root.	Cube Root
44	138.23	1,520.53	1,936	85,184	6.633	3.530
46	144.51	1,661 90	2,116	97,336	6.782	3.583
48	150.80	1,809.56	2,304	110,592	6.928	3.634
50	157.08	1,963.50	2,500	125,000	7.071	3.684
52	163.36	2,123.72	2,704	140,608	7.211	3.732
54	169.65	2,290.22	2,916	157,464	7.348	3.779
56	175.93	2,463.01	3,136	175,616	7.483	3.825
58	182.21	2,642.08	3,364	195,112	7.615	3.870
60	188.50	2,827.43	3,600	216,000	7.745	3.914
62	194.78	3,019.07	3,844	238,328	7.874	3.957
64	201.06	3.216.99	4,096	262,144	8.000	4.000
66	207.34	3,421.19	4,356	287,496	8.124	4.041
68	213.63	3,631.68	4,624	314,432	8.246	4.081
70	219.91	3,848.45	4,900	343,000	8.366	4.121
72	226.19	4,071.50	5,184	373,248	8.485	4.160
74	232.48	4,300.84	5.476	405,224	8.602	4.198
76	238.76	4,536.46	5,776	438,976	8.717	4.235
78	245.04	4,778.36	6,084	474,552	8.831	4 272
80	251.33	5,026.55	6,400	512,000	8.944	4.308
82	257.61	5,281.02	6,724	551,368	9.055	4.344
84	263.89	5,541.77	7,056	592,704	9.165	4.379
86	270.18	5,808.80	7,396	636,056	9.273	4.414
88	276.46	6,082.12	7,744	681,472	9.380	4.447
90	282.74	6,361.73	8,100	729,000	9.486	4.481
92	289.03	6,647.61	8,464	778,688	9.591	4.514
94	295.31	6,939.78	8,836	830,584	9.695	4.546
96	301.59	7,238.23	9,216	884,736	9.797	4.578
98	307.88	7,542.96	9,604	941,192	9.899	4.610
100	314.16	7,853.98	10,000	1,000,000	10.000	4.641
102	320.41	8,171.28	10,404	1,061,208	10.099	4.672
104	326.73	8,494.87	10,816	1,124,864	10.198	4.702
106	333.01	8,824.73	11,236	1,191,016	10.295	4.732
108	339.29	9,160.88	11,664	1,259,712	10.392	4.762
110	345.57	9,503.32	12,100	1,331,000	10.488	4.791
112	351.86	9,852.03	12,544	1,404,928	10.583	4.820
114	358.14	10,207.03	12,996	1,481,544	10.677	4.848
116	364.42	10,568 32	13,456	1,560,896	10.770	4.876
118	370.71	10,935.88	13,924	1,643,032	10.862	4.904
120	376.99	11,309.73	14,400	1,728,000	10.954	4.932
122	383.27	11,689.87	14,884	1,815,848	11.045	4.959

AREAS OF CIRCLES AND LENGTHS OF THE SIDES OF SQUARES OF THE SAME AREA

Diam. of Circle in Inches.	Area of Circle in Square Inches.	Sides of Square of Same Area in Square Inches.	Diam. of Circle in Inches.	Area of Circle in Square Inches.	Sides of Square of Same Area in Square Inches.	Diam. of Circle in Inches.	Area of Circle in Square Inches.	Sides of Square of Same Area in Square Inches.
1.	.785	.89	21.	346.36	18.61	41.	1320.26	36.34
.½	1.767	1.33	.½	363.05	19.05	.½	1352.66	36.78
2.	3.142	1.77	22.	380.13	19.50	42.	1385.45	37.22
.½	4.909	2.22	.½	397.61	19.94	.½	1418.63	37.66
3.	7.069	2.66	23.	415.48	20.38	43.	1452.20	38.11
.½	9.621	3.10	.½	433.74	20.83	.½	1486.17	38.55
4.	12.566	3.54	24.	452.39	21.27	44.	1520.53	38.99
.½	15.904	3.99	.½	471.44	21.71	.½	1555.29	39.44
5.	19.635	4.43	25.	490.88	22.16	45.	1590.43	39.88
.½	23.758	4.87	.½	510.71	22.60	.½	1625.97	40.32
6.	28.274	5.32	26.	530.93	23.04	46.	1661.91	40.77
.½	33.183	5.76	.½	551.55	23.49	.½	1698.23	41.21
7.	38.485	6.20	27.	572.56	23.93	47.	1734.95	41.65
.½	44.179	6.65	.½	593.96	24.37	.½	1772.06	42.10
8.	50.266	7.09	28.	615.75	24.81	48.	1809.56	42.58
.½	56.745	7.53	.½	637.94	25.26	.½	1847.46	42.98
9.	63.617	7.98	29.	660.52	25.70	49.	1885.75	43.43
.½	70.882	8.42	.½	683.49	26.14	.½	1924.43	43.87
10.	78.540	8.86	30.	706.86	26.59	50.	1963.50	44.31
.½	86.590	9.30	.½	730.62	27.03	.½	2002.97	44.75
11.	95.03	9.75	31.	754.77	27.47	51.	2042.83	45.20
.½	103.87	10.19	.½	779.31	27.92	.½	2083.08	45.64
12.	113.10	10.63	32.	804.25	28.36	52.	2123.72	46.08
.½	122.72	11.08	.½	829.58	28.80	.½	2164.76	46.53
13.	132.73	11.52	33.	855.30	29.25	53.	2206.19	46.97
.½	143.14	11.96	.½	881.41	29.69	.½	2248.01	47.41
14.	153.94	12.41	34.	907.92	30.13	54.	2290.23	47.86
.½	165.13	12.85	.½	934.82	30.57	.½	2332.83	48.30
15.	176.72	13.29	35.	962.11	31.02	55.	2375.83	48.74
.½	188.69	13.74	.½	989.80	31.46	.½	2419.23	49.19
16.	201.06	14.18	36.	1017.88	31.90	56.	2463.01	49.63
.½	213.83	14.62	.½	1046.35	32.35	.½	2507.19	50.07
17.	226.98	15.07	37.	1075.21	32.79	57.	2551.76	50.51
.½	240.53	15.51	.½	1104.47	33.23	.½	2596.73	50.96
18.	254.47	15.95	38.	1134.12	33.68	58.	2642.09	51.40
.½	268.80	16.40	.½	1164.16	34.12	.½	2687.84	51.84
19.	283.53	16.84	39.	1194.59	34.56	59.	2733.98	52.29
.½	298.65	17.28	.½	1225.42	35.01	.½	2780.51	52.73
20.	314.16	17.72	40.	1256.64	35.45	60.	2827.74	53.17
.½	330.06	18.17	.½	1288.25	35.89	.½	2874.76	53.62

FLUE AREA REQUIRED FOR THE PASSAGE OF A GIVEN VOLUME OF AIR AT A GIVEN VELOCITY

Volume in Cubic Feet per Minute.	Velocity in Feet Per Minute.													
	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600
100	48	36	29	24	21	18	16	14	13	12	11	10	9.6	9.
125	60	45	36	30	26	23	20	18	16	15	14	13	12.	11.3
150	72	54	43	36	31	27	24	22	20	18	16	15	14.4	13.5
175	84	63	50	42	36	32	28	25	23	21	19	18	16.8	15.8
200	96	72	58	48	41	36	32	29	26	24	22	21	19.2	18.
225	108	81	65	54	46	41	36	32	29	27	25	23	21.6	20.3
250	120	90	72	60	51	45	40	36	33	30	28	26	24.	22.5
275	132	99	79	66	57	50	44	40	36	33	30	28	26.4	24.8
300	144	108	86	72	62	54	48	43	39	36	33	31	28.8	27.
325	156	117	94	78	67	59	52	47	43	39	36	33	31.2	29.3
350	168	126	101	84	72	63	56	50	46	42	39	36	33.6	31.5
375	180	135	108	90	77	68	60	54	49	45	42	39	36.	33.8
400	192	144	115	96	82	72	64	58	52	48	44	41	38.4	36.
425	204	153	122	102	87	77	68	61	56	51	47	44	40.8	38.3
450	216	162	130	108	93	81	72	65	59	54	50	46	43.2	40.5
475	228	171	137	114	98	86	76	68	62	57	53	49	45.6	42.8
500	240	180	144	120	103	90	80	72	65	60	55	51	48.	45.
525	252	189	151	126	108	95	84	76	69	63	58	54	50.4	47.3
550	264	198	158	132	113	99	88	79	72	66	61	57	52.8	49.5
575	276	207	166	138	118	104	92	83	75	69	64	59	55.2	51.8
600	288	216	173	144	123	108	96	86	79	72	66	62	57.6	54.
625	300	225	180	150	129	113	100	90	82	75	69	64	60.	56.3
650	312	234	187	156	134	117	104	94	85	78	72	67	62.4	58.5
675	324	243	194	162	139	122	108	97	88	81	75	69	64.8	60.8
700	336	252	202	168	144	126	112	101	92	84	78	72	67.2	63.
725	348	261	209	174	149	131	116	104	95	87	80	75	69.6	65.3
750	360	270	216	180	154	135	120	108	98	90	83	77	72.	67.5
775	372	279	223	186	159	140	124	112	101	93	86	80	74.4	69.8
800	384	288	230	192	165	144	128	115	105	96	89	82	76.8	72.
825	396	297	238	198	170	149	132	119	108	99	91	85	79.2	74.3
850	408	306	245	204	175	153	136	122	111	102	94	87	81.6	76.5
875	420	315	252	210	180	158	140	126	115	105	97	90	84.	78.8
900	432	324	259	216	185	162	144	130	118	108	100	93	86.4	81.
925	444	333	266	222	190	167	148	133	121	111	103	95	88.8	83.3
950	456	342	274	228	195	171	152	137	124	114	105	98	91.2	85.5
975	468	351	281	234	201	176	156	140	128	117	108	100	93.6	87.8
1000	480	360	288	240	206	180	160	144	131	120	111	103	96.	90.

FLUE AREA REQUIRED FOR THE PASSAGE OF A GIVEN VOLUME OF AIR AT A GIVEN VELOCITY

Volume in Cubic Feet per Minute.	Velocity in Feet Per Minute.													
	1700	1800	1900	2000	2100	2200	2300	2400	2600	2700	2800	2900	3000	3100
100	8.5	8	7.6	7.2	6.9	6.6	6.3	6.	5.5	5.3	5.1	5.	4.8	4.6
125	10.6	10	9.5	9.	8.6	8.2	7.8	7.5	6.9	6.7	6.4	6.2	6.	5.8
150	12.7	12	11.4	10.8	10.3	9.8	9.4	9.	8.	8.	7.7	7.5	7.2	7.
175	14.8	14	13.3	12.6	12.	11.5	11.	10.5	9.7	9.3	9.	8.7	8.4	8.1
200	16.9	16	15.2	14.4	13.7	13.1	12.5	12.	11.1	10.7	10.3	9.9	9.6	9.3
225	19.1	18	17.1	16.2	15.6	14.7	14.1	13.5	12.5	12.	11.6	11.2	10.8	10.4
250	21.2	20	19.	18.	17.1	16.4	15.7	15.	13.9	13.3	12.9	12.4	12.	11.6
275	23.3	22	21.8	19.8	18.9	18.	17.2	16.5	15.2	14.7	14.1	13.7	13.2	12.8
300	25.4	24	22.7	21.6	20.6	19.6	18.8	18.	16.6	16.	15.4	14.9	14.4	13.9
325	27.5	26	24.6	23.4	22.3	21.3	20.6	19.5	18.	17.3	16.7	16.1	15.6	15.1
350	29.6	28	26.5	25.2	24.	22.9	21.9	21.	19.4	18.7	18.	17.4	16.8	16.3
375	31.8	30	28.4	27.	25.7	24.5	23.5	22.5	20.8	20.	19.3	18.6	18.	17.4
400	33.9	32	30.3	28.8	27.4	26.2	25.	24.	22.2	21.3	20.6	19.8	19.2	18.6
425	36.	34	32.2	30.6	29.1	27.8	26.6	25.5	23.5	22.7	21.9	21.1	20.4	19.7
450	38.1	36	34.1	32.4	30.9	29.5	28.2	27.	24.9	24.	23.1	22.3	21.6	20.9
475	40.2	38	36.	34.2	32.6	31.1	29.7	28.5	26.3	25.3	24.4	23.6	22.8	22.1
500	42.4	40	37.9	36.	34.3	32.7	31.3	30.	27.7	26.7	25.7	24.8	24.	23.2
525	44.5	42	39.8	37.8	36.	34.4	32.9	31.5	29.1	28.	26.9	25.	25.2	24.4
550	46.6	44	41.7	38.6	37.7	36.	34.4	33.	30.5	29.3	28.3	27.3	26.4	25.5
575	48.7	46	43.6	41.4	39.4	37.6	36.	34.5	31.9	30.7	29.6	28.5	27.6	26.7
600	50.8	48	45.5	43.2	41.1	39.3	37.6	36.	33.2	32.	30.8	29.8	28.8	27.8
625	52.9	50	47.4	45.	42.9	40.9	39.1	37.5	34.6	33.3	32.1	31.	30.	29.
650	55.1	52	49.3	46.8	44.6	42.5	40.7	39.	36.	34.7	33.4	32.2	31.2	30.2
675	57.2	54	51.2	48.6	46.3	44.1	42.3	40.5	37.5	36.	34.7	33.5	32.4	31.3
700	59.3	56	53.1	50.4	48.	45.8	43.8	42.	38.8	37.3	36.	34.7	33.6	32.5
725	61.4	58	55.	52.2	49.7	47.4	45.4	43.5	40.2	38.7	37.3	36.	34.8	33.6
750	63.5	60	56.9	54.	51.4	49.1	47.	45.	41.5	40.	38.6	37.2	36.	34.8
775	65.6	62	58.8	56.3	53.1	50.7	48.5	46.5	42.9	41.3	39.9	38.5	37.2	36.
800	67.8	64	60.6	57.6	54.9	52.4	50.1	48.	44.3	42.7	41.2	39.7	38.4	37.1
825	69.9	66	62.5	59.4	56.6	54.	51.7	49.5	45.7	44.	42.4	40.9	39.6	38.3
850	72.	68	64.4	61.2	58.4	55.6	53.2	51.	47.1	45.3	43.7	42.2	40.8	39.4
875	74.	70	67.3	63.	60.	57.3	54.8	52.5	48.5	46.7	45.	43.4	42.	40.6
900	76.2	72	68.2	64.8	61.7	58.9	56.3	54.	49.9	48.	46.3	44.6	43.2	41.8
925	78.4	74	70.1	66.6	63.4	60.5	57.9	55.5	51.3	49.3	47.6	46.	44.4	42.9
950	80.5	76	72.	68.4	65.1	62.2	59.5	57.	52.6	50.7	48.8	47.1	45.6	44.1
975	82.6	78	73.9	70.2	66.8	63.8	61.0	58.5	54.	52.	50.2	48.4	46.8	45.3
1000	84.7	80	75.8	72.	68.7	66.	62.6	60.	55.4	53.3	51.4	49.6	48.	46.4

Diameter of Air Pipes for Various Velocities

Cubic Feet Air per Minute	$\frac{1}{32}$ Oz. Pressure	$\frac{1}{16}$ Oz. Pressure	⅛ Oz. Pressure	¼ Oz. Pressure	½ Oz. Pressure	¾ Oz. Pressure	1 Oz. Pressure
	Velocity 11 Feet per Second	Velocity 15.5 Feet per Second	Velocity 22 Feet per Second	Velocity 43 Feet per Second	Velocity 60.9 Feet per Second	Velocity 74.7 Feet per Second	Velocity 86.25 Feet per Second
			Diameters of Pipe, in Inches				
100	5.3	4.5	3.8	2.7	2.3	2	1.9
200	7.5	6.4	5.3	3.8	3.2	2.9	2.7
300	9.2	7.7	6.5	4.7	3.9	3.6	3.3
400	10.6	9	7.5	5.4	4.5	4.1	3.8
500	11.8	10.1	8.4	6	5.1	4.6	4.3
600	12.9	11.1	9.2	6.6	5.5	5	4.7
700	14	11.9	9.9	7.1	6	5.4	5
800	15	13	10.6	7.6	6.4	5.8	5.4
900	15.9	13.4	11.3	8	6.8	6.1	5.7
1000	16.7	14.1	11.8	8.5	7.1	6.4	6
1250	18.8	15.8	13.2	9.5	8	7.2	6.7
1500	20.5	17.2	14.5	10.4	8.7	7.9	7.4
1750	22.3	18.6	15.6	11.2	9.4	8.5	7.9
2000	23.6	20	16.7	12	10.1	9.1	8.6
2500	26.6	22.3	18.7	13.4	11.3	10.5	9.4
3000	28.9	24.4	20.5	14.7	12.4	11.1	10.3
3500	32	26.6	22.3	15.8	13.3	12.1	11.6
4000	33.4	28	23.6	16.9	13.8	12.8	11.9
4500	35.4	29.7	25.1	17.9	15.1	13.6	12.7
5000	37.3	31.4	26.4	18.9	15.8	14.3	13.4
6000	40.9	34.4	28.9	20.7	17.4	15.7	14.6
7000	44.1	37.1	31.2	22.3	18.8	17	15.8
8000	47.2	39.7	33.4	23.9	20.1	18.1	16.9
9000	50	42.2	35.4	25.3	21.3	19.2	17.9
10000	52.7	44.4	37.3	26.7	22.4	20.3	18.9
15000	64.6	54.3	45.7	32.7	27.4	24.8	23.1
20000	74.6	62.5	52.7	37.7	31.7	28.6	26.6
25000	84	70.2	59	42.2	35.5	32	29.8
30000	91.3	76.9	64.6	46.2	38.8	35.1	32.6
35000	98.6	83	69.8	49.8	41.8	37.9	35.2
40000	105.5	88.2	74.6	53.3	43.6	40.5	37.7
50000	118	99.3	83.4	59.6	50.1	45.3	42.1

TABLE OF SIZE OF CHIMNEYS FOR POWER PLANTS

Diameter in Inches	Height of Chimneys and Commercial Horsepower											Side of Square Chimney Inches	Effective Area Square Feet	Actual Area Square Feet
	50 Feet	60 Feet	70 Feet	80 Feet	90 Feet	100 Feet	110 Feet	125 Feet	150 Feet	175 Feet	200 Feet			
18	23	25	27	......	......	......	......	......	......	......	......	16	.97	1.77
21	35	38	41	......	......	......	......	......	......	......	......	19	1.47	2.41
24	49	54	58	62	......	......	......	......	......	......	......	22	2.08	3.14
27	65	72	78	83	......	......	......	......	......	......	......	24	2.78	3:98
30	84	92	100	107	113	......	......	......	......	......	......	27	3.58	4.91
33	......	115	125	133	141	......	......	......	......	......	......	30	4.48	6,94
36	......	141	152	163	173	182	......	......	......	......	......	32	5.47	7.07
39	......	......	183	196	208	219	......	......	......	......	......	35	6.57	8.30
42	......	......	216	231	245	258	271	......	......	......	......	38	7.76	9.62
48	......	......	......	311	330	348	365	389	......	......	......	43	10.44	12.57
54	......	......	......	363	427	449	472	503	651	......	......	48	13.51	15.90
60	......	......	......	505	536	565	593	632	602	748	......	54	16.96	19.64
66	......	......	......	......	658	684	728	776	849	918	981	59	20.83	23.76
72	......	......	......	......	792	835	876	934	1,023	1,105	1,181	64	25.08	28.27
78	......	......	......	......	......	995	1,038	1,107	1,212	1,310	1,400	70	29.73	33.18
84	......	......	......	......	......	1,163	1,214	1,294	1,418	1,531	1,637	75	34.76	38.48
90	......	......	......	......	......	1,344	1,415	1,496	1,639	1,770	1,893	80	40.19	44.18
96	......	......	......	......	......	1,537	1,616	1,720	1,876	2,027	2,167	86	46.01	50.27
102	......	......	......	......	......	......	......	1,946	2,133	2,303	2,462	90	52.23	56.75
108	......	......	......	......	......	......	......	2,192	2,402	2,594	2,773	96	58.83	63.62
114	......	......	......	......	......	......	......	2,459	2,687	2,903	3,003	101	65.83	70.88
120	......	......	......	......	......	......	......	......	2,990	3,230	3,452	106	73.22	78.54
126	......	......	......	......	......	......	......	......	3,308	3,573	3,820	112	81.00	86 59
132	......	......	......	......	......	......	......	......	3,642	3,735	4,205	117	89.19	95.03
138	......	......	......	......	......	......	......	......	3,791	4,311	4,608	122	97.75	103.86
144	......	......	......	......	......	......	......	......	4,357	4,407	5,031	127	106.72	113.10

Table of Necessary Increased Pipe Diameters for Different Lengths

Length of Pipe	30′	60′	90′	120′	150′	180′	210′	240′	270′	300′
Diameter of Blower Outlet, in Inches	Dia. of Pipe should be	Dia. of Pipe should be	Dia. of Pipe should be	Dia. of Pipe should be	Dia. of Pipe should be	Dia. of Pipe should be	Dia. of Pipe should be	Dia. of Pipe should be	Dia. of Pipe should be	Dia. of Pipe should be
3	3¼	3⅝	4	4¼	4½	4¾	5	5⅛	5⅜	5½
3½	3¾	4⅛	4½	4⅞	5	5¼	5½	5⅝	5⅞	6⅛
4	4⅜	4¾	5⅛	5⅜	5¾	6	6¼	6½	6¾	7
4½	5	5⅜	5¾	6	6⅜	6¾	7	7¼	7½	7⅞
5	5½	6	6⅜	6¾	7⅛	7½	7¾	8⅛	8⅜	8¾
6	6½	7	7⅝	8	8½	9	9⅜	9¾	10⅛	10½
7	7⅝	8¼	8⅞	9⅜	10	10⅜	10⅞	11⅞	11¾	12⅛
8	8¾	9½	10⅛	10¾	11⅜	11⅞	12⅜	12⅜	13⅜	13⅞
9	10	10¾	11½	12⅛	12¾	13⅜	14	14½	15⅛	15⅝
10	11	11⅞	12¾	13½	14¼	14⅞	15½	16⅛	16¾	17⅜
11	12	13	13⅞	14¾	15⅝	16⅜	17⅛	17¾	18½	19⅛
12	13⅛	14¼	15¼	16⅛	17	17⅞	18⅝	19⅜	20⅛	20⅞
13	14¼	15⅜	16½	17½	18⅜	19¼	20⅛	21	21¾	22⅝
14	15⅜	16⅝	17¾	18⅞	19¾	20¾	21¾	22⅝	23½	24¼
15	16½	17¾	19	20⅛	21¼	22¼	23¼	24¼	25⅛	26
16	17½	19	20⅜	21½	22⅝	23¾	24¾	25⅞	26⅞	27¾
17	17⅝	20⅛	21½	22¾	24	25¼	26⅜	27½	28½	29½
18	19¾	21⅜	22¾	24¼	25½	26¾	27⅞	29⅛	30⅛	31¼
19	20⅞	22½	24	25½	27	28¼	29½	30¾	31⅞	33
20	22	23⅝	25⅜	27⅞	28⅜	29¾	31	32¼	33½	34¾
21	23	24⅞	26⅝	28¼	29¾	31⅛	32½	33⅞	35¼	36⅜
22	24⅛	26⅛	27⅞	29½	31⅛	32⅝	34⅛	35½	36⅞	38⅛
23	25¼	27¼	29⅛	30⅞	32½	34⅛	35⅝	37⅛	38½	39⅞
24	26½	28½	30⅜	32¼	34	35⅝	37¼	38¾	40¼	41⅝
Length of Pipe	30′	60′	90′	120′	150′	180′	210′	240′	270′	300′
Length of Mouth-piece.	9″	15″	21″	27″	33″	39″	42″	48″	54″	60″

Pressures, Corresponding Velocities and Water Column Heights

Table of Pressures per Sq. In. in Ounces	Correspond. Height of Water Col. in Inches	Air Velocities per Minute, Corres. to Pressures per Sq. Inch	Table of Pressures per Sq. In. in Ounces	Correspond. Height of Water Col. in Inches	Air Velocities per Minute, Corres. to Pressures per Sq. Inch
¼	.4335	2584.80	10	17.340	16683.51
½	.8671	3657.60	11	19.074	17533.50
¾	1.3005	4482.00	12	20.808	18350.34
1	1.734	5175.00	13	22.542	19138.26
2	3.468	7338.24	14	24.276	19900.68
3	5.202	9006.42	15	26.010	20640.48
4	6.936	10421.58	16	27.750	21360.00
5	8.670	11676.00	17	29.478	22060.80
6	10.404	12817.08	18	31.212	22745.40
7	12.138	13872.72	19	32.946	23415.00
8	13.872	14861.16	20	34.680	24070.80
9	15.606	15795.06			

TABLE OF AREAS AND CUBICAL CONTENTS

Ceiling Heights

Room Size	Area	8½′	9′	9½′	10′	10½′	11′	12′	13′	15′
10x10	100	850	900	950	1000	1050	1100	1200	1300	1500
10x10½	105	893	945	997	1050	1103	1155	1260	1365	1575
10x11	110	935	990	1045	1100	1155	1210	1320	1430	1650
10x11½	115	978	1035	1092	1150	1208	1265	1380	1495	1725
10x12	120	1020	1080	1140	1200	1260	1320	1440	1560	1800
10x12½	125	1063	1125	1187	1250	1313	1375	1500	1625	1875
10x13	130	1105	1170	1235	1300	1365	1430	1560	1690	1950
10x13½	135	1148	1215	1282	1350	1418	1485	1620	1755	2025
10x14	140	1190	1260	1330	1400	1470	1540	1680	1820	2100
10x14½	145	1233	1305	1377	1450	1523	1595	1740	1885	2175
10x15	150	1275	1350	1425	1500	1575	1650	1800	1950	2250
10x15½	155	1318	1395	1472	1550	1628	1705	1860	2015	2325
10x16	160	1360	1440	1520	1600	1680	1760	1920	2080	2400
10x16½	165	1403	1485	1567	1650	1733	1815	1980	2045	2475
10x17	170	1445	1530	1615	1700	1785	1870	2040	2210	2550
10x17½	175	1488	1575	1662	1750	1838	1925	2100	2275	2625
10x18	180	1530	1620	1710	1800	1890	1980	2160	2340	2700
10x18½	185	1573	1665	1757	1850	1943	2035	2220	2405	2775
10x19	190	1615	1710	1805	1900	1995	2090	2280	2470	2850
10x19½	195	1658	1755	1852	1950	2048	2145	2340	2535	2925
10x20	200	1700	1800	1900	2000	2100	2200	2400	2600	3000
11x11	121	1029	1089	1149	1210	1271	1331	1452	1573	1815
11x12	132	1122	1188	1254	1320	1386	1452	1584	1716	1980
11x13	143	1216	1287	1358	1430	1502	1573	1716	1859	2145
11x14	154	1309	1386	1463	1540	1617	1694	1848	2002	2310
11x15	165	1403	1485	1567	1650	1733	1815	1980	2145	2475
11x16	176	1496	1584	1672	1760	1848	1936	2112	2288	2640
11x17	187	1590	1683	1776	1870	1964	2057	2244	2431	2805
11x18	198	1683	1782	1881	1980	2079	2178	2376	2574	2970
11x19	209	1777	1881	1986	2090	2195	2299	2508	2717	3135
11x20	220	1870	1980	2090	2200	2310	2420	2640	2860	3300
11x21	231	1964	2079	2194	2310	2426	2541	2772	3003	3465
11x22	242	2057	2178	2299	2420	2541	2662	2904	3146	3630
12x12	144	1224	1296	1368	1440	1512	1584	1728	1872	2160
12x13	156	1326	1404	1482	1560	1638	1716	1872	2028	2340
12x14	168	1428	1512	1596	1680	1764	1848	2016	2184	2520
12x15	180	1530	1620	1710	1800	1890	1980	2160	2340	2700
12x16	192	1632	1728	1824	1920	2016	2112	2304	2496	2880
12x17	204	1734	1836	1938	2040	2142	2244	2448	2652	3060
12x18	216	1836	1944	2052	2160	2268	2376	2592	2808	3240
12x19	228	1938	2052	2166	2280	2394	2508	2736	2964	3420
12x20	240	2040	2160	2280	2400	2520	2640	2880	3120	3600
12x21	252	2142	2268	2394	2520	2646	2772	3024	3276	3780
12x22	264	2244	2376	2508	2640	2772	2904	3168	3432	3960
12x23	276	2346	2484	2622	2760	2898	3036	3312	3588	4140
12x24	288	2448	2592	2736	2880	3024	3168	3456	3744	4320
13x13	169	1437	1521	1605	1690	1775	1859	2028	2197	2535
13x14	182	1547	1638	1729	1820	1911	2002	2184	2366	2730

TABLE OF AREAS AND CUBICAL CONTENTS

Ceiling Heights

Room Size	Area	8½′	9′	9½′	10′	10½′	11′	12′	13′	15′
13x15	195	1658	1755	1852	1950	2048	2145	2340	2535	2925
13x16	208	1768	1872	1976	2080	2184	2288	2496	2704	3120
13x17	221	1879	1989	2099	2210	2321	2431	2652	2873	3315
13x18	234	1989	2106	2223	2340	2457	2574	2808	3042	3510
13x19	247	2100	2223	2346	2470	2594	2717	2964	3211	3705
13x20	260	2210	2340	2470	2600	2730	2860	3120	3380	3900
13x21	273	2321	2457	2593	2730	2867	3003	3276	3549	4095
13x22	286	2431	2574	2717	2860	3003	3146	3432	3718	4290
13x23	299	2542	2691	2840	2990	3140	3289	3588	3887	4485
13x24	312	2652	2808	2964	3120	3276	3432	3744	4056	4680
13x25	325	2763	2925	3087	3250	3413	3575	3900	4225	4875
13x26	338	2873	3042	3211	3380	3549	3718	4056	4394	5070
14x14	196	1666	1764	1862	1960	2058	2156	2352	2548	2940
14x15	210	1785	1890	1995	2100	2205	2310	2520	2730	3150
14x16	224	1904	2016	2128	2240	2352	2464	2688	2912	3360
14x17	238	2023	2142	2261	2380	2499	2618	2856	3094	3570
14x18	252	2142	2268	2394	2520	2646	2772	3024	3276	3780
14x19	266	2261	2394	2527	2660	2793	2926	3192	3458	3990
14x20	280	2380	2520	2660	2800	2940	3080	3360	3640	4200
14x21	294	2499	2646	2793	2940	3087	3234	3528	3822	4410
14x22	308	2618	2772	2926	3080	3234	3388	3696	4004	4620
14x23	322	2737	2898	3059	3220	3381	3542	3864	4186	4830
14x24	336	2856	3024	3192	3360	3528	3696	4032	4368	5040
14x25	350	2975	3150	3325	3500	3675	3850	4200	4550	5250
14x26	364	3094	3276	3458	3640	3822	4004	4368	4732	5460
14x27	378	3213	3402	3591	3780	3969	4158	4536	4914	5670
14x28	392	3332	3528	3724	3920	4116	4312	4704	5096	5880
15x15	225	1913	2025	2137	2250	2363	2475	2700	2925	3375
15x16	240	2040	2160	2280	2400	2520	2640	2880	3120	3600
15x17	255	2168	2295	2422	2550	2678	2805	3060	3315	3825
15x18	270	2295	2430	2565	2700	2835	2970	3240	3150	4050
15x19	285	2423	2565	2707	2850	2993	3135	3420	3705	4275
15x20	300	2550	2700	2850	3000	3150	3300	3600	3900	4500
15x21	315	2678	2835	2992	3150	3308	3465	3780	4095	4725
15x22	330	2805	2970	3135	3300	3465	3630	3960	4290	4950
15x23	345	2933	3105	3277	3450	3623	3795	4140	4485	5175
15x24	360	3060	3240	3420	3600	3780	3960	4320	4680	5400
15x25	375	3188	3375	3562	3750	3938	4125	4500	4875	5625
15x26	390	3315	3510	3705	3900	4095	4290	4680	5070	5850
15x27	405	3443	3645	3847	4050	4253	4455	4860	5265	6075
15x28	420	3570	3780	3990	4200	4410	4620	5040	5460	6300
15x29	435	3698	3915	4132	4350	4568	4785	5220	5655	6525
15x30	450	3825	4050	4275	4500	4725	4950	5400	5850	6750
16x16	256	2176	2304	2432	2560	2688	2816	3072	3328	3840
16x17	272	2312	2448	2584	2720	2856	2992	3264	3556	4080
16x18	288	2448	2592	2736	2880	3024	3168	2456	3744	4320
16x19	304	2584	2736	2888	3040	3192	3344	3648	3952	4560
16x20	320	2720	2880	3040	3200	3360	3520	3840	4160	4800

TABLE OF AREAS AND CUBICAL CONTENTS
Ceiling Heights

Room Size	Area	8½′	9′	9½′	10′	10½′	11′	12′	13′	15′
16x21	336	2856	3024	3192	3360	3528	3696	4032	4368	5040
16x22	352	2992	3168	3344	3520	3696	3872	4224	4576	5280
16x23	368	3128	3312	3496	3680	3864	4048	4416	4784	5520
16x24	384	3264	3456	3648	3840	4032	4224	4608	4992	5760
16x25	400	3400	3600	3800	4000	4200	4400	4800	5200	6000
16x26	416	3536	3744	3952	4160	4368	4576	4992	5408	6240
16x27	432	3672	3888	4104	4320	4536	4752	5184	5616	6480
16x28	448	3808	4032	4256	4480	4704	4928	5376	5824	6720
16x29	464	3944	4176	4408	4640	4872	5104	5568	5032	6960
16x30	480	4080	4320	4560	4800	5040	5280	5760	6240	7200
16x31	496	4216	4464	4712	4960	5208	5456	5952	6448	7440
16x32	512	4352	4608	4864	5120	5376	5632	6144	6656	7680
18x18	324	2754	2916	3078	3240	3402	3564	3888	4212	4860
18x20	360	3060	3240	3420	3600	3780	3960	4320	4680	5400
18x22	396	3366	3564	3762	3960	4158	4356	4752	5148	5940
18x24	432	3672	3888	4104	4320	4536	4752	5184	5616	6480
18x26	468	3978	4212	4446	4680	4914	5148	5616	6084	7020
18x28	504	4284	4536	4788	5040	5292	5544	6048	6552	7560
18x30	540	4590	4860	5130	5400	5670	5940	6480	7020	8100
18x32	576	4896	5184	5472	5760	6048	6336	6912	7488	8640
18x34	612	5202	5508	5814	6120	6426	6732	7344	7956	9180
18x36	648	5508	5832	6156	6480	6804	7128	7776	8424	9720
20x20	400	3400	3600	3800	4000	4200	4400	4800	5200	6000
20x22	440	3740	3960	4180	4400	4620	4840	5280	5720	6600
20x24	480	4080	4320	4560	4800	5040	5280	5760	6240	7200
20x26	520	4420	4680	4940	5200	5460	5720	6240	6760	7800
20x28	560	4760	5040	5320	5600	5880	6160	6720	7280	8400
20x30	600	5100	5400	5700	6000	6300	6600	7200	7800	9000
20x32	640	5440	5760	6080	6400	6720	7040	7680	8320	9600
20x34	680	5780	6120	6460	6800	7140	7480	8160	8840	10200
20x36	720	6120	6480	6840	7200	7560	7920	8640	9360	10800
20x38	760	6460	6840	7220	7600	7980	8360	9120	9880	11400
20x40	800	6800	7200	7600	8000	8400	8800	9600	10400	12000
21x20	420	3520	3780	3970	4200	4410	4620	5040	5460	6300
21x22	462	3927	4158	4389	4620	4851	5082	5544	6006	6930
21x24	504	4284	4536	4788	5040	5292	5544	6048	6552	7560
21x26	546	4641	4914	5187	5460	5733	6006	6552	7098	8190
21x28	588	4998	5292	5586	5880	6174	6468	7056	7644	8820
21x30	630	5355	5670	5985	6300	6615	6930	7560	8190	9450
21x32	672	5712	6048	6384	6720	7056	7392	8064	8736	10080
21x34	714	6069	6426	6783	7140	7497	7854	8568	9282	10710
21x36	756	6426	6804	7182	7560	7938	8316	9072	9828	11340
21x38	798	6783	7182	7581	7980	8379	8778	9576	10374	11970
21x40	840	7140	7560	7980	8400	8820	9240	10080	10920	12600
22x20	440	3740	3960	4180	4400	4620	4840	5280	5720	6600
22x22	484	4114	4356	4598	4840	5082	5324	5808	6292	7260
22x24	528	4488	4752	5016	5280	5544	5808	6336	6864	7920
22x26	572	4862	5148	5434	5720	6006	6292	6864	7436	8580

TABLE OF AREAS AND CUBICAL CONTENTS

Ceiling Heights

Room Size	Area	8½′	9′	9½′	10′	10½′	11′	12′	13′	15′
22x28	616	5236	5544	5852	6160	6468	6776	7392	8008	9240
22x30	660	5610	5940	6270	6600	6930	7260	7920	8580	9900
22x32	704	5984	6336	6688	7040	7392	7744	8448	9152	10560
22x34	748	6358	6732	7106	7480	7854	8228	8976	9724	11220
22x36	792	6732	7128	7524	7920	8316	8712	9504	10296	11880
22x38	836	7106	7524	7942	8360	8778	9196	10032	10868	12540
22x40	880	7480	7920	8360	8800	9240	9680	10560	11440	13200
23x20	460	3910	4140	4370	4600	4830	5060	5520	5980	6900
23x22	506	4301	4554	4807	5060	5313	5566	6072	6578	7590
23x24	552	4692	4968	5244	5520	5796	6072	6624	7176	8280
23x26	598	5083	5382	5681	5980	6279	6578	7176	7774	8970
23x28	644	5474	5796	6118	6440	6762	7084	7728	8372	9660
23x30	690	5865	6210	6555	6900	7245	7590	8280	8970	10350
23x32	736	6256	6624	6992	7360	7728	8096	8832	9568	11040
23x34	782	6647	7038	7429	7820	8211	8602	9384	10166	11730
23x36	828	7038	7452	7966	8280	8694	9108	9936	10764	12420
23x38	874	7429	7866	8303	8740	9177	9614	10488	11362	13110
23x40	920	7820	8280	8740	9200	9660	10120	11040	11960	13800
24x20	480	4080	4320	4560	4800	5040	5280	5760	6240	7200
24x22	528	4488	4752	5016	5280	5544	5808	6336	6864	7920
24x24	576	4896	5184	5472	5760	6048	6336	6912	7488	8640
24x26	624	5304	5616	5928	6240	6552	6864	7488	8112	9360
24x28	672	5712	6048	6384	6720	7056	7392	8064	8736	10080
24x30	720	6120	6480	6840	7200	7560	7920	8640	9360	10800
24x32	768	6528	6912	7296	7680	8064	8448	9216	9984	11520
24x34	816	6936	7344	7752	8160	8568	8976	9792	10608	12240
24x36	864	7344	7776	8208	8640	9072	9504	10368	11232	12960
24x38	912	7752	8208	8664	9120	9576	10032	10944	11856	13680
24x40	960	8160	8640	9120	9600	10080	10560	11520	12480	14400
25x20	500	4250	4500	4750	5000	5250	5500	6000	6500	7500
25x22	550	4675	4950	5225	5500	5775	6050	6600	7150	8250
25x24	600	5100	5400	5700	6000	6300	6600	7200	7800	9000
25x26	650	5525	5850	6175	6500	6825	7150	7800	8450	9750
25x28	700	5950	6300	6650	7000	7350	7700	8400	9100	10500
25x30	750	6375	6750	7125	7500	7875	8250	9000	9750	11250
25x32	800	6800	7200	7600	8000	8400	8800	9600	10400	12000
25x34	850	7225	7650	8075	8500	8925	9350	10200	11050	12750
25x36	900	7650	8100	8550	9000	9450	9900	10800	11700	13500
25x38	950	8075	8550	9025	9500	9975	10450	11400	12350	14250
25x40	1000	8500	9000	9500	10000	10500	11000	12000	13000	15000

PROPORTIONING DUCTS FOR PUBLIC BUILDINGS

In public buildings the sizes of air-conveying ducts from fans or heaters to vertical induction flues, and the sizes of these flues, depend upon the velocities of the air flowing in such ducts and flues. The essential factors in determining these velocities are: The limitations of economical rotative speed of fans from the standpoint of power, the limitations of air velocities on account of noise or by reason of increasing friction as velocities increase; limitation of velocity of inflowing air through registers into rooms; the desirability of as high a velocity of air as is permissible under the limitations referred to in order to get as quick a conveyance of heat units from the heater to the rooms to be heated as possible; and the necessary initial and intermediate velocities to overcome the resistance existing in each particular system or case.

The size of vertical flues to the registers in the rooms is determined by the maximum velocities allowable in avoiding drafts and noise in the rooms. Practice has shown that the best velocities for the registers should be from 200 to 400 feet per minute over the face of the register depending upon the size and location; floor registers from 125 to 175 feet. The velocity in the vertical flues leading to the registers should be from 400 to 750. The sizes of these vertical flues is determined largely by the size of register desirable. In general, the velocity in these risers should be low, in order to obtain as uniform a velocity as possible over the register area.

The velocity in the horizontal ducts leading from the apparatus to the vertical risers is determined chiefly by the resistance of the duct. In practice these velocities will vary anywhere from 700 feet to 1200 feet depending upon the size, length of the duct, number of elbows, etc. A designer with considerable experience may proportion these ducts so as to give very uniform distribution without going into any extended calculation. However, it is desirable to have a correct method as a basis. For the benefit of engineers and architects we give here the method employed by this company in the determination of duct velocities and sizes.

The principal losses in piping systems for public buildings are in the horizontal ducts where the velocity is the highest. The losses in these ducts depend upon the velocity, the size and length of duct and upon the number of elbows. There is also considerable loss in pressure as the air enters the duct. An ideal system should

take all these factors into consideration, and so proportion the velocities that the resistance would be practically equal in all ducts regardless of the length, etc.

The system which we employ accomplishes this in a practical manner and at the same time avoids any laborious calculation. For each duct a factor may be obtained by inspection in accordance with the following formula:

$$F = 2\tfrac{1}{2} + \frac{L}{4W} + \frac{N}{6}$$

This factor represents the loss by friction in terms of velocity head. The first term, $2\frac{1}{2}$, is approximately the number of times the velocity head lost by entrance to the pipe, entrance to the vertical flue, and loss in riser and register. The second factor represents the loss due to length and size of pipe; L is the length in feet and W is the approximate width in inches. The third term represents that proportion of the pressure lost in elbows, and N is the number of long radius elbows. One square elbow is figured equal to two long radius elbows. In checking over the piping layout the factors for the various ducts are first found as above and from these factors the velocity in the respective ducts are ascertained directly. In determining these velocities it is usual to allow a loss not exceeding one-fourth of the total fan pressure. This in practice usually amounts to about $\frac{1}{4}$ of an inch. The velocity corresponding to a pressure of one-quarter of an inch is 2000, and since the velocities vary as the square root of the pressure, the factor F and the velocity V will give a loss of $\frac{1}{4}$ of an inch if

$$V = \frac{2000}{\sqrt{F}}$$

In this manner the velocities are accurately and conveniently proportioned. The table on page 117 from an actual case illustrates the variation in velocities which occur in a correctly proportioned system, and the table on page 119 shows standard size of registers and risers in public buildings.

NOTE: The foregoing rules for proportioning ducts in public buildings, are here used by courtesy of the Buffalo Forge Co. Pages named refer to their catalogue.

Buffalo Fan System of Heating and Ventilating

TABLE FOR EQUALIZING THE DIAMETERS OF PIPES

Always extend main pipes, so as to make branch pipes as short as possible. Parties putting up blast pipes are are very liable to think that, because the combined area of four 3-inch pipes is the same as one 6-inch pipe, the four pipes will convey the same quantity of air the same distance with the same ease and freedom that the 6-inch will; whereas it actually does take 5.7—almost six 3-inch pipes of same length. Again, nine 6-inch pipes will have the combined area of one 18-inch pipe, but in actual practice it takes just sixteen 6-inch pipes to do the work of one 18-inch pipe of same length. This is due to the excess of friction for every cubic foot of air in the small pipes over that in the large. The large figures at the top of each column give the diameters in inches of the branch pipes. The figures at the intersection of the horizontal line with the vertical give the number of pipes, of the diameter given at the top of the column, that will be equal in capacity for conveying air to one given opposite in the first column, lengths being equal. For larger sizes use same proportions.

Diameter of Main Blast Pipe, in Inches	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	22	24	26	28	30	36	42	48	54	60
2																													
3	2.7																												
4	5.7	2.0																											
5	9.8	3.6	1.8																										
6	16	5.7	2.8	1.6																									
7	23	8.3	4.1	2.3	1.5																								
8	32	12	5.7	3.2	2.1	1.4																							
9	42	16	7.6	4.3	2.8	1.9	1.3																						
10	56	20	9.9	5.7	3.6	2.4	1.7	1.3																					
11	71	26	12	7.0	4.5	3.1	2.2	1.7	1.3																				
12	88	32	16	9.0	5.7	3.8	2.8	2.0	1.6	1.2																			
13	107	39	19	11	6.9	4.7	3.4	2.5	1.9	1.5	1.2																		
14	129	47	23	13	8.3	5.7	4.1	3.0	2.3	1.8	1.5	1.2																	
15	152	56	27	16	9.9	6.7	4.8	3.6	2.8	2.2	1.8	1.4	1.2																
16	180	65	32	18	11	7.9	5.7	4.2	3.2	2.6	2.1	1.7	1.4	1.2															
17	208	76	37	21	13	9.2	6.6	4.9	3.8	2.9	2.4	2.0	1.6	1.4	1.2														
18	239	88	43	24	16	10	7.7	5.7	4.3	3.4	2.8	2.3	1.9	1.6	1.3	1.2													
19	275	100	49	28	18	12	8.8	6.5	5.0	3.9	3.2	2.6	2.2	1.8	1.6	1.3	1.2												
20	313	114	56	32	20	14	9.9	7.4	5.7	4.5	3.6	2.9	2.5	2.1	1.7	1.5	1.3	1.4											
22	398	145	71	41	26	18	13	9.3	7.2	5.7	4.5	3.7	3.1	2.6	2.2	1.9	1.7	1.4	1.3										
24	493	180	88	60	32	22	16	12	8.9	7.6	5.7	4.6	3.8	3.2	2.9	2.4	2.1	1.8	1.6	1.2									
26	605	219	108	62	39	27	19	14	11	8.6	6.9	5.7	4.7	4.0	3.4	2.9	2.5	2.2	1.9	1.5	1.2								
28	725	265	129	74	48	32	23	17	13	10	8.3	6.8	5.7	4.8	4.1	3.6	3.0	2.6	2.3	1.8	1.5	1.2							
30	864	315	154	88	56	38	28	20	16	12	9.9	8.0	6.7	5.7	4.7	4.1	3.6	3.0	2.6	2.2	1.7	1.4	1.2						
36	1361	497	243	139	88	60	43	32	25	19	16	13	11	8.9	7.6	6.5	5.7	5.0	4.3	3.4	2.7	2.2	1.9	1.6					
42	2000	730	358	205	129	88	63	47	36	29	23	19	16	13	11	9.6	8.5	7.3	6.4	5.0	4.1	3.3	2.8	2.3	1.5				
48	2792	1081	492	282	180	123	88	66	50	39	32	26	22	18	16	13	12	10	8.9	7.0	5.7	4.7	3.8	3.2	2.1	1.4			
54	3753	1368	671	384	244	166	119	88	68	53	43	35	29	24	21	18	16	15	12	9.4	7.6	6.2	5.2	4.3	2.8	1.9	1.3		
60	4879	1781	872	499	314	215	154	115	88	69	56	46	38	32	27	23	20	18	16	12	9.9	8.1	6.7	5.7	3.6	2.4	1.8	1.3	

Table for Determining the Size of Registers and Flues for a Certain Number of Changes Per Hour.

N—Times Per hr.	V—Velocity in Feet per Minute										
	250	300	350	400	450	500	600	700	800	900	1000
2	.000133	.000110	.000095	.000083	.000074	.000066	.000055	.000047	.000042	.000037	.000033
3	.000200	.000166	.000143	.000125	.000111	.000100	.000083	.000072	.000063	.000055	.000050
4	.000266	.000222	.000191	.000166	.000148	.000133	.000111	.000095	.000083	.000074	.000066
5	.000330	.000278	.000238	.000208	.000185	.000166	.000138	.000119	.000106	.000093	.000083
6	.000400	.000333	.000286	.000250	.000222	.000200	.000166	.000143	.000125	.000111	.000100
7	.000465	.000389	.000333	.000291	.000259	.000234	.000144	.000166	.000146	.000130	.000116
8	.000530	.000445	.000380	.000333	.000296	.000266	.000222	.000190	.000166	.000148	.000133
9	.000600	.000500	.000429	.000375	.000333	.000300	.000250	.000215	.000188	.000166	.000150
10	.000660	.000556	.000417	.000417	.000371	.000333	.000278	.000238	.000208–	.000185	.00016

To find size flue for any conditions, multiply cubical contents of room by appropriate factor in table, and add 10% for friction.

EXAMPLE: Size of room 24x30x13; cubical contents equals 9360 cubic feet. Let changes per hour =6, and velocity at register equal 300 feet per minute. Then 9360 x .000333 (factor in table) = 3.1 square feet = the NET actual opening of register, AFTER ALLOWING FOR GRILLE WORK, etc.

Table for Determining the Size of Registers and Flues for a Given Air Supply Per Person.

A=Cubic ft. air per person per minute.
P=Number of persons in room.

A	Velocity in Feet per Minute										
	250	300	350	400	450	500	600	700	800	900	1000
10	.040	.033	.029	.025	.022	.020	.017	.015	.013	.011	.010
15	.060	.050	.042	.037	.033	.030	.025	.021	.019	.017	.015
20	.080	.066	.057	.050	.044	.040	.033	.029	.025	.022	.020
25	.100	.083	.071	.063	.055	.050	.042	.036	.032	.028	.025
30	.120	.100	.085	.075	.066	.060	.050	.043	.038	.033	.030
35	.140	.116	.100	.087	.077	.070	.058	.050	.044	.039	.035
40	160	.132	.114	.100	.088	.080	.066	.057	.050	.044	.040
45	.180	.149	.128	.112	.099	.090	.075	.064	.056	.050	.045
50	.200	.166	.142	.125	.111	.100	.083	.071	.063	.056	.050

FORMULA: Area of Flue or Register in feet $=\frac{P x A}{V}$

To find size flue or register: Multiply the number of persons in the room by appropriate factor in table.

EXAMPLE: Number of persons =45. Air required=30 cubic feet per minute. Velocity allowed =300 feet per minute. Then $45 \times .100 = 4.5$ square feet.

Allowance should be made for grille work if used, and for friction in long flues.

AMERICAN SCHOOL BUILDINGS.

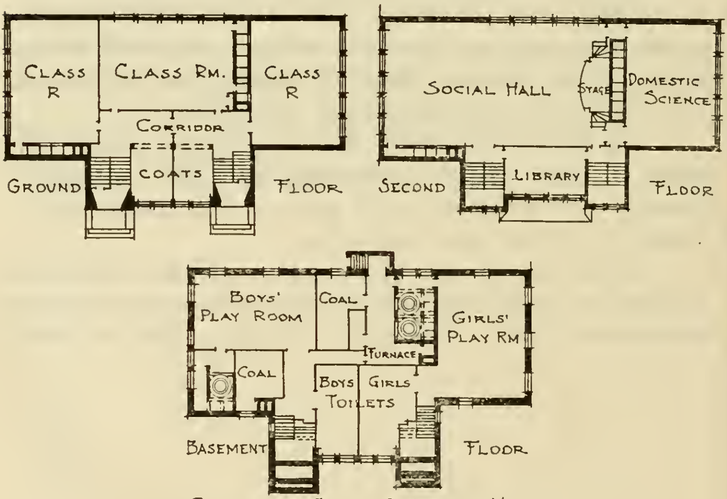
The following pages illustrate many of the best school buildings in America. Many of them are but recently completed,—some are still under construction, the illustrations having been obtained from the architects' drawings. Buildings which are not so recent are also shown, because they illustrate architectural standards still recognized as the practice of the best offices, and well worthy of study and reference.

While every school building problem is worthy of the designer's best endeavor, not all sets of conditions render ideal results possible. All school building "standards" must necessarily be considered only as averages. The thing to be done depends on the time, the place, the money in hand, educational requirements and other important items. A principle may be universal, but its application must be particular and specific.

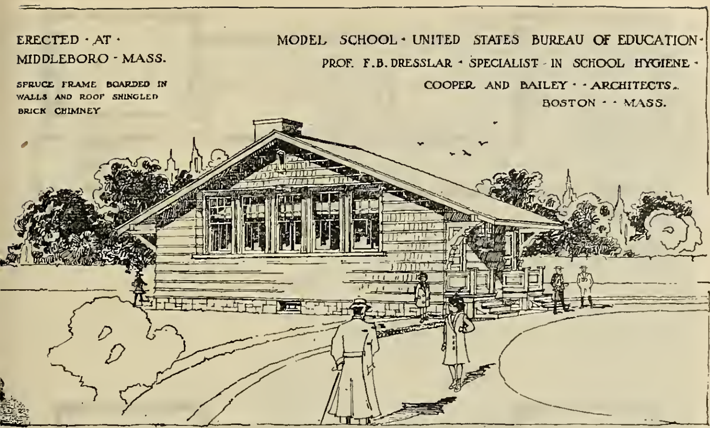
The buildings illustrated all typify the same general principles of school design,—representing the latest and best in America,—but the results are of widely varying character as influenced by all the factors referred to.

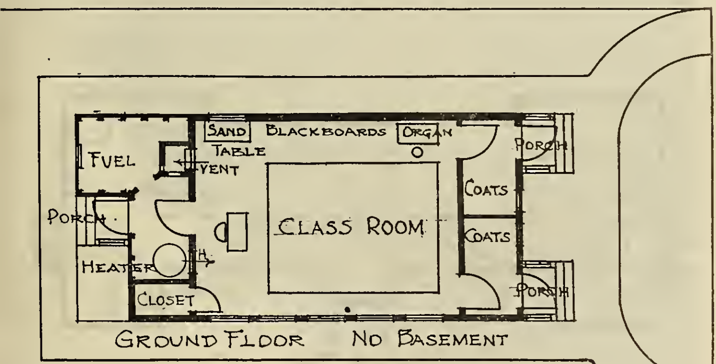
In most cases the floor plans not given with the buildings are occupied with class rooms only, or the usual basement rooms, the arrangement of which is indicated by the plans which are shown.

Cordaville School, Southboro, Mass.
Cooper & Bailey, Architects.

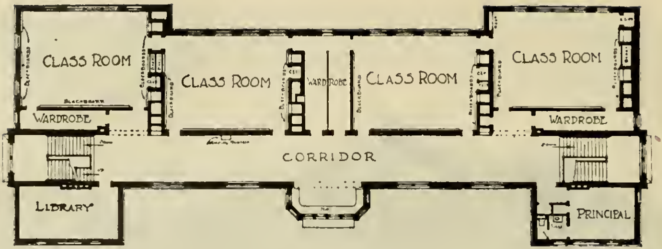


CORDAVILLE SCHOOL SOUTHBORO MASS.
COOPER & BAILEY • • ARCHITECTS

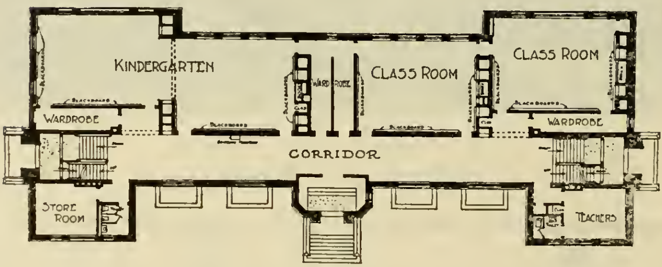




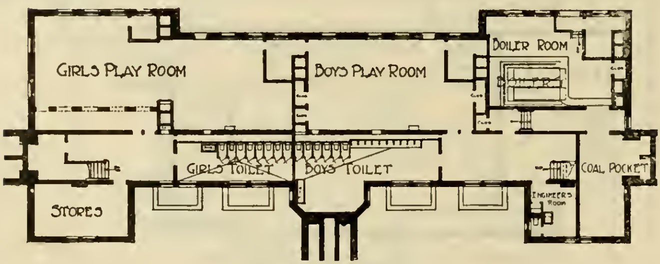
MODEL SCHOOL MIDDLEBORO MASS. U.S. BUREAU OF ED-UCATION : COOPER & BAILEY, ARCHITECTS



Second Floor Plan.



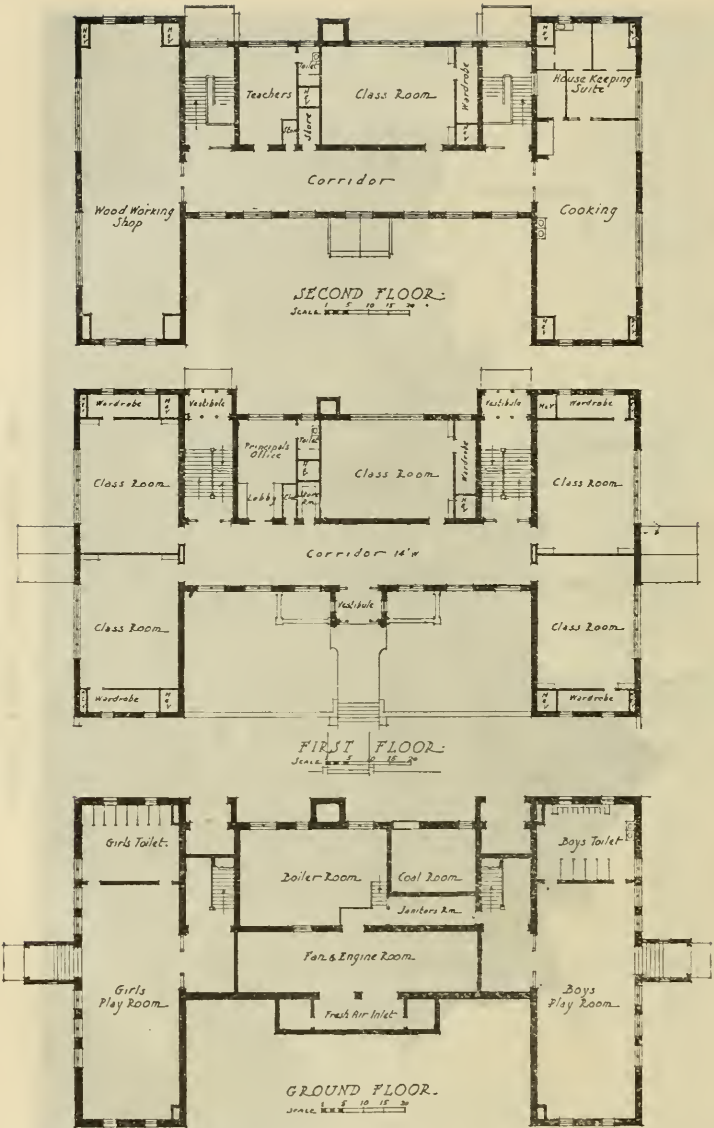
First Floor Plan.



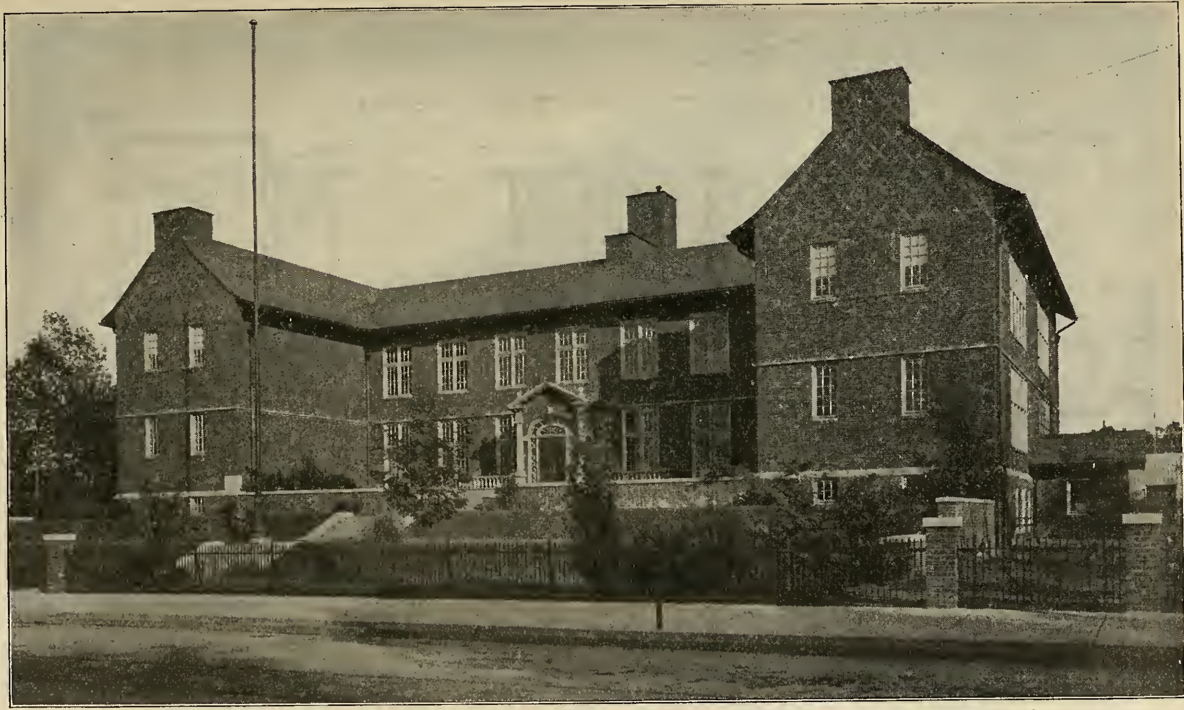
Basement Plan.

Michael Driscoll School, Brookline, Mass.
Kilham & Hopkins, Architects.

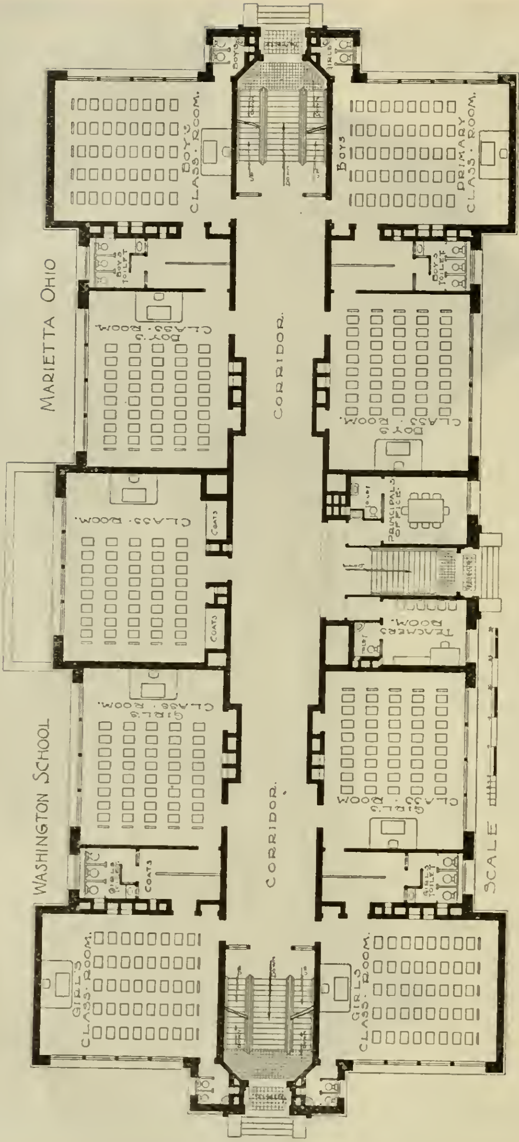
Michael Driscoll School, Brookline, Mass.
Kilham and Hopkins, Architects, Boston, Mass.



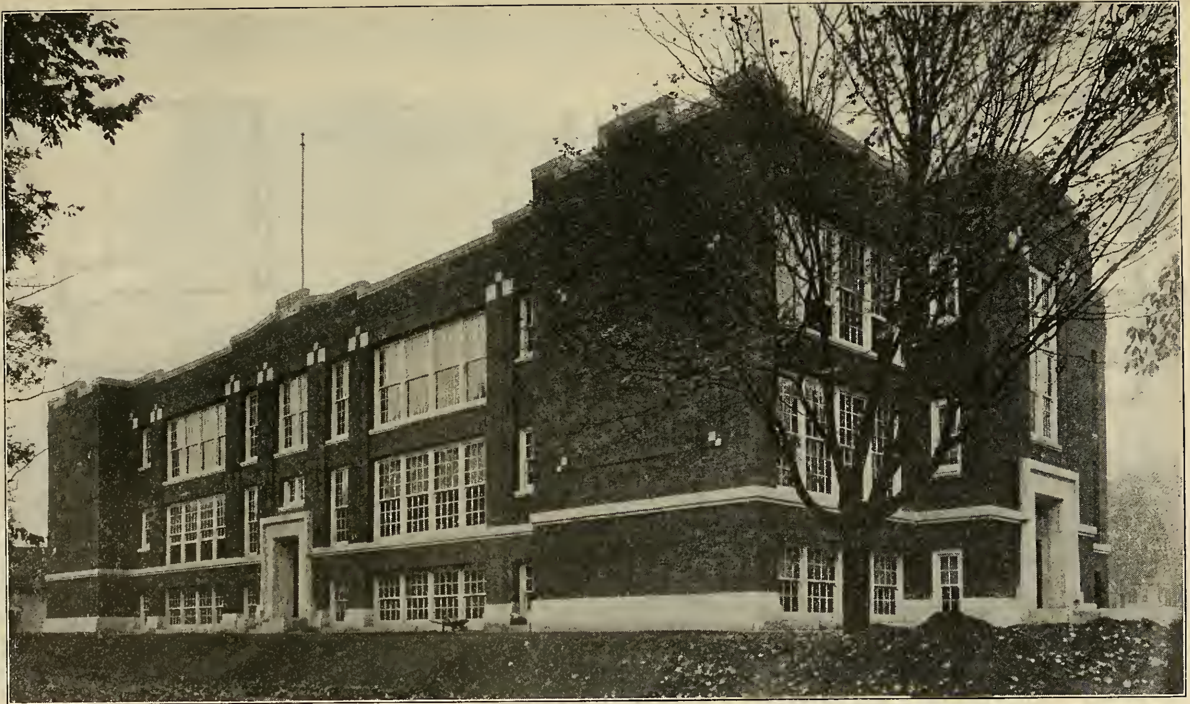
Floor Plans. Delany School. Virginia Ave. and Bowen Street.



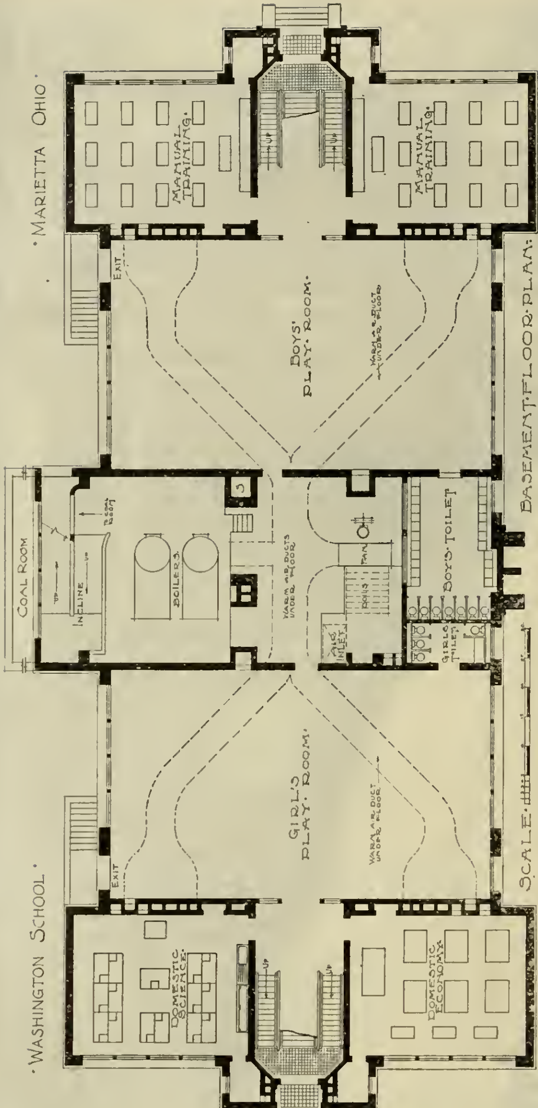
Delaney School, St. Louis, Mo. Wm. B. Ittner, Architect, St. Louis. Cost 22.5c cu. ft.



First Floor Plan, Washington School, Marietta, Ohio.

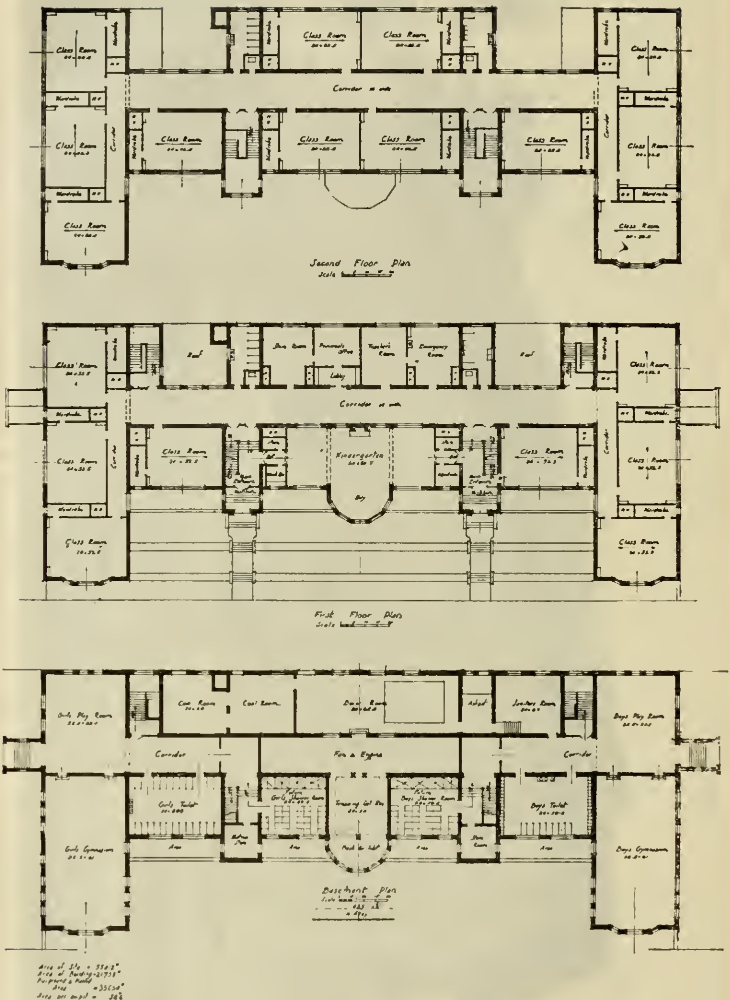


Washington School (Primary) Marietta, Ohio. Fireproof. Cost 16c per cu. ft. Wilbur T. Mills, Architect, Columbus, O.



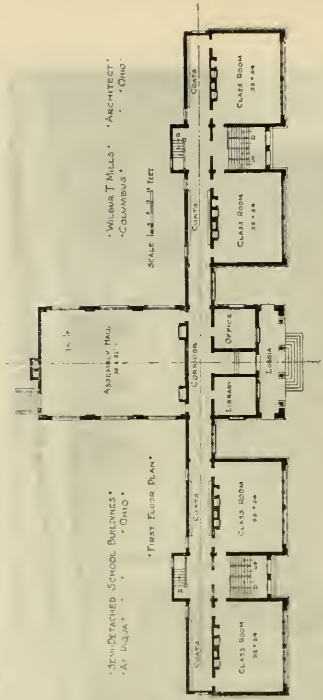
·Washington School· ·Marietta Ohio·
Basement·Floor·Plan:
Manual Training·
Manual Training·
Boys' Play· Room·
Girl's Play· Room·
Warm air duct under floor
Warm air ducts under floor
Exit
Exit
Coal Room
Incline
Boilers
Fan
Air Inlet
Boy's Toilet
Girls Toilet
Domestic Science·
Domestic Economy
Up
Scale·

Silas W. Gardner School. Laurel, Miss., De Buys, Churchill & La Bouisse, Architects, New Orleans.



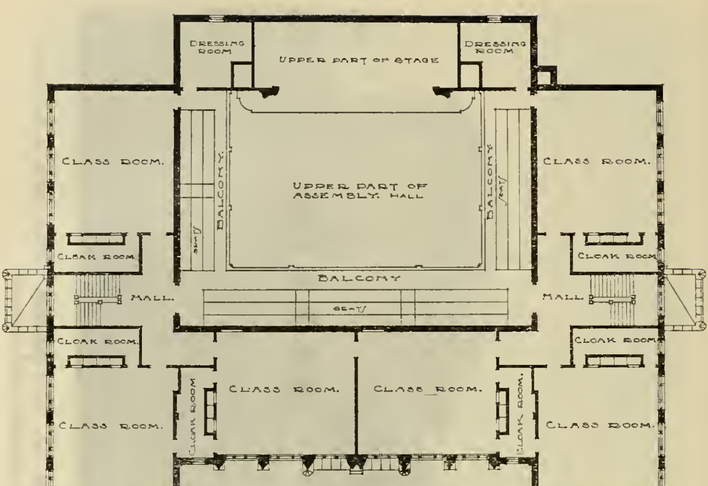
Floor Plans, Bryan Hill School. Gano and Florissant Avenues.

Bryan Hill School, St. Louis, Mo. Wm. B. Ittner, Architect, St. Louis. Cost 17.3 cu. ft.

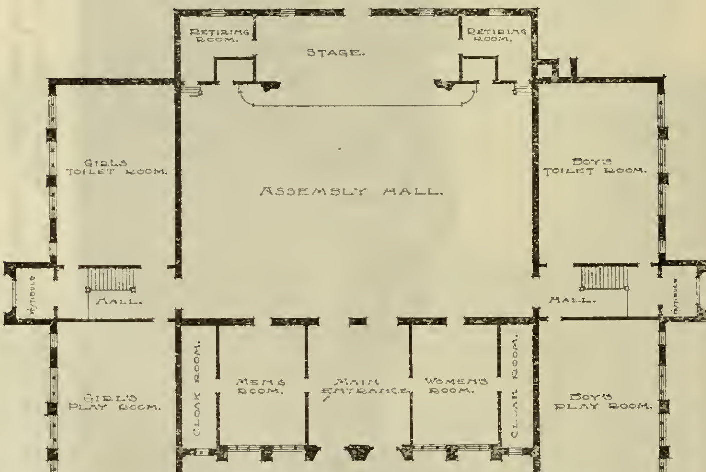


St. Mary's School, Marion, O.
Wilbur T. Mills, Architect, Columbus, O.

Favorite Hill School, Piqua, O. Wilbur T. Mills, Architect, Columbus, O. Cost $26,000. Other units to be added. An example of good design for township and centralized high schools.



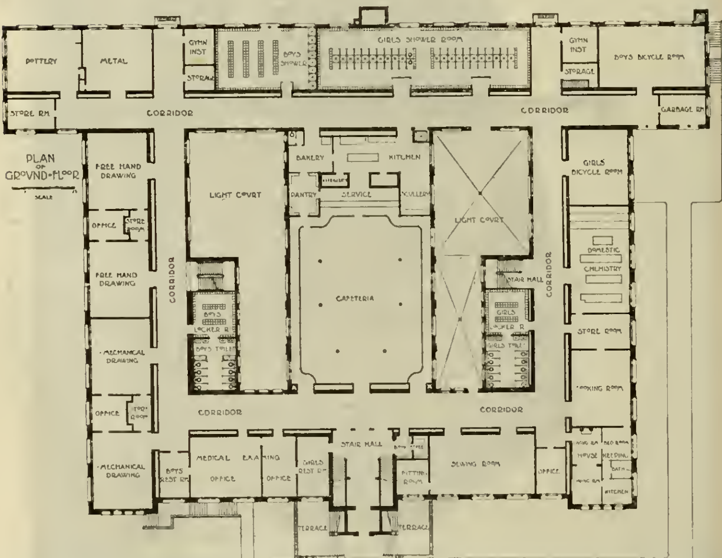
-FIRST·FLOOR·PLAN-
ST ROSE'S SCHOOL·CHELSEA MASS



-GROUND·FLOOR·PLAN-
ST ROSE'S SCHOOL·CHELSEA, MASS

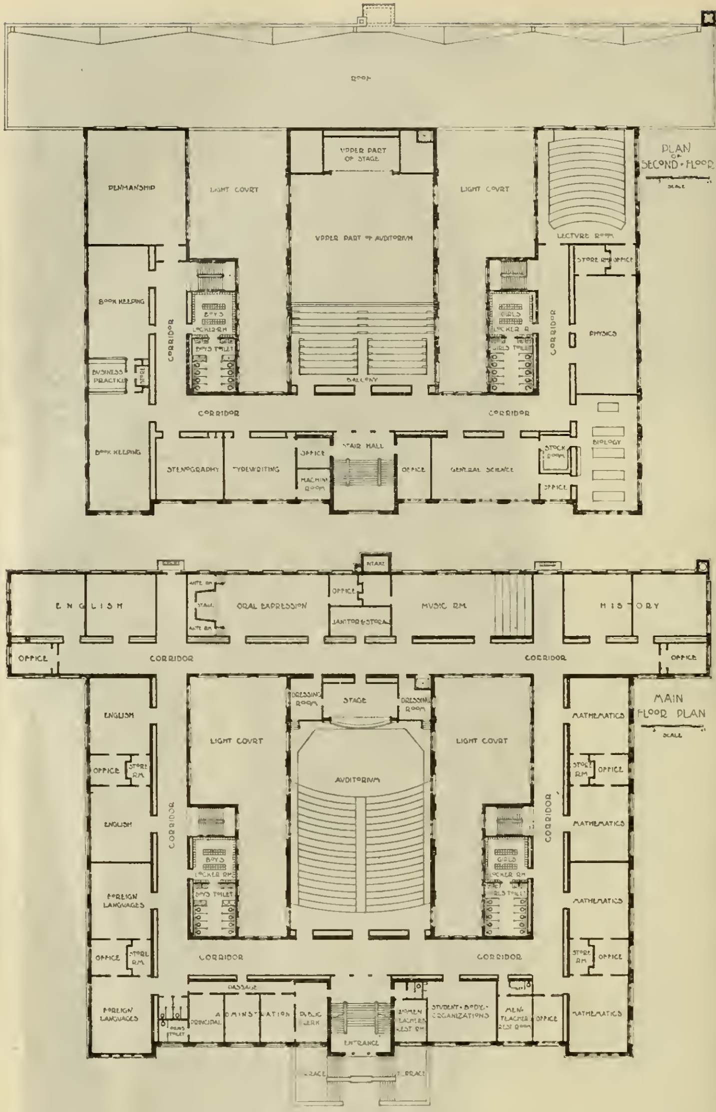
St. Rose's School, Chelsea, Mass. Mathew Sullivan, Architect, Boston.

Domestic Economy Room, Emerson School, Gary, Ind.

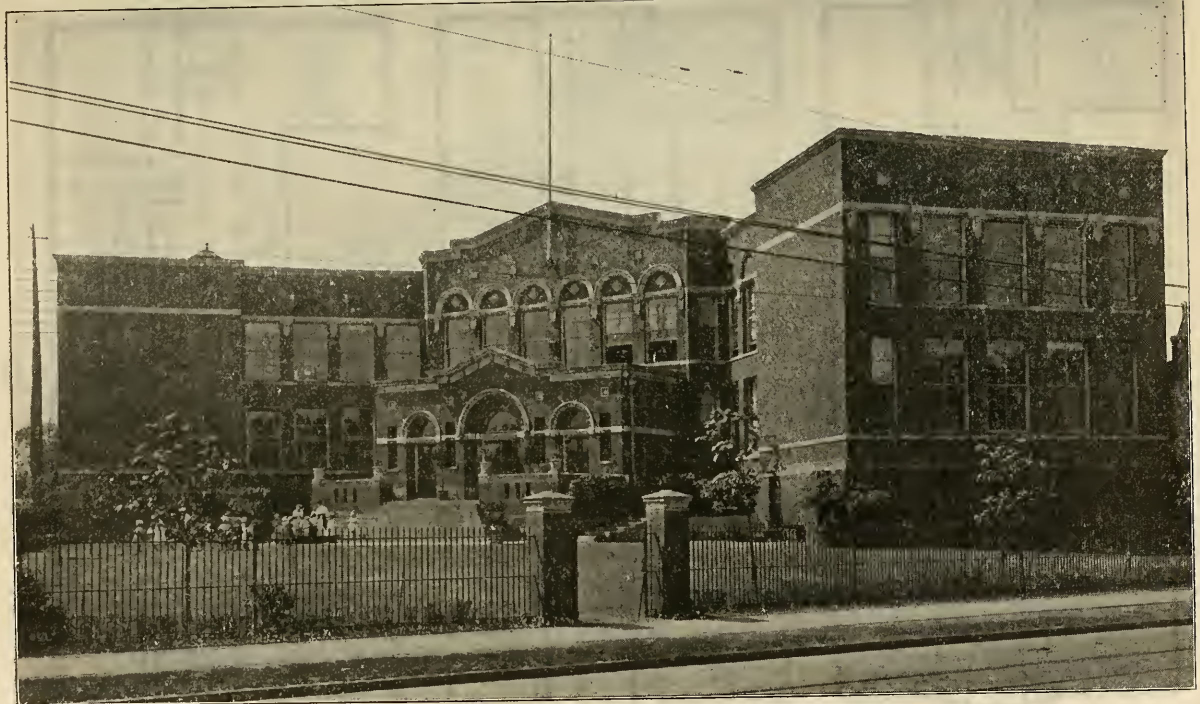


Boyle Heights Intermediate School, A. F. Rosenheim, Architect, Los Angeles.

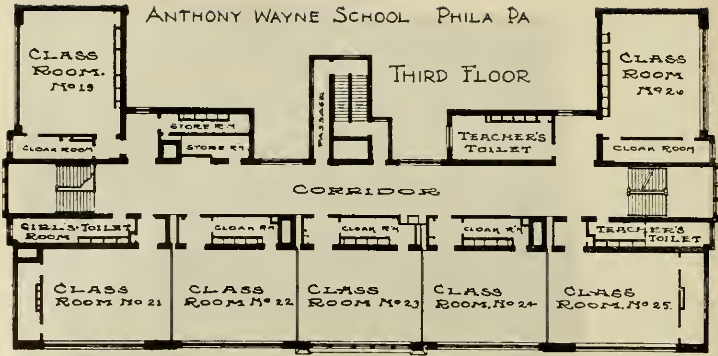
Boyle Heights Intermediate School, Los Angeles, Cal. A. F. Rosenheim, Architect.

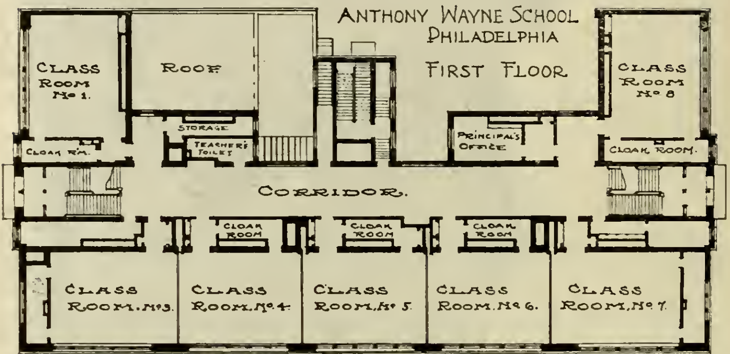


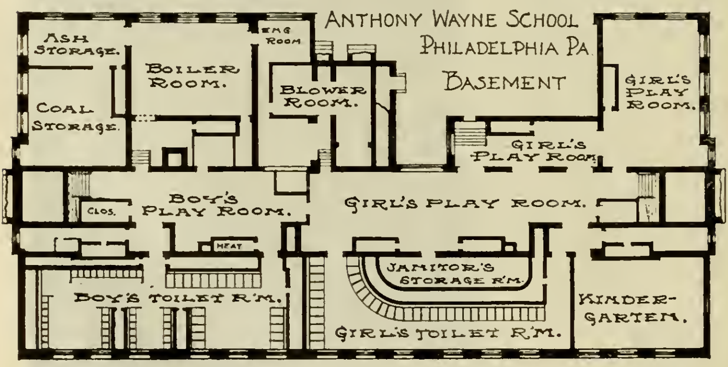
Boyle Heights Intermediate School, Los Angeles, A. F. Rosenheim, Architect.



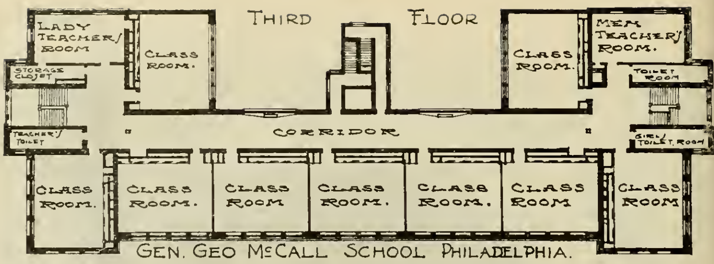
Watterson School, Cleveland, O. F. S. Barnum, Architect.

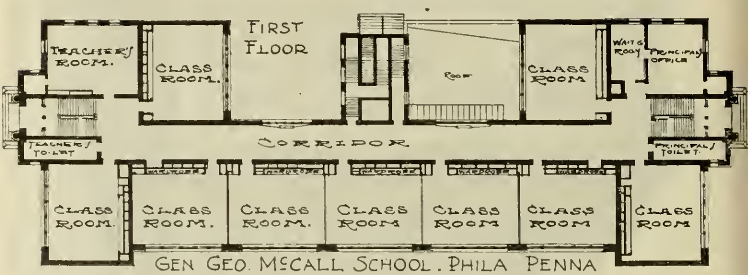

ANTHONY WAYNE SCHOOL PHILA PA
THIRD FLOOR
CLASS ROOM. No 19
CLASS ROOM No 20
STORE R'M
STORE R'M
PASSAGE
TEACHER'S TOILET
CLOAK ROOM
CLOAK ROOM
CORRIDOR
GIRL'S TOILET ROOM
CLOAK R'M
CLOAK R'M
CLOAK R'M
TEACHER'S TOILET
CLASS ROOM No 21
CLASS ROOM No 22
CLASS ROOM No 23
CLASS ROOM. No 24
CLASS ROOM. No 25.

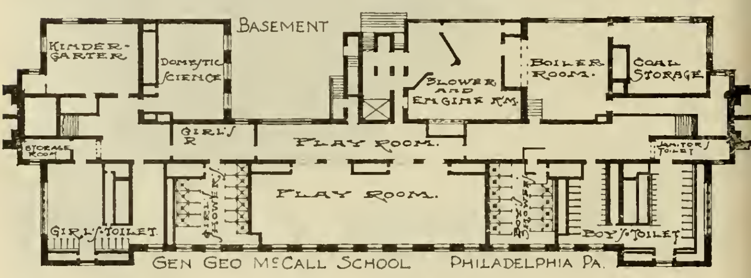

ANTHONY WAYNE SCHOOL PHILADELPHIA
FIRST FLOOR
CLASS ROOM No 1.
ROOF
CLASS ROOM No 8
STORAGE
TEACHERS TOILET
PRINCIPAL'S OFFICE
CLOAK R'M.
CLOAK ROOM.
CORRIDOR.
CLOAK ROOM
CLOAK ROOM
CLOAK ROOM
CLASS ROOM. No 3.
CLASS ROOM. No 4.
CLASS ROOM. No 5.
CLASS ROOM. No 6.
CLASS ROOM. No 7.


ANTHONY WAYNE SCHOOL PHILADELPHIA PA
BASEMENT
ASH STORAGE.
BOILER ROOM.
ENG ROOM
BLOWER ROOM.
GIRL'S PLAY ROOM.
COAL STORAGE.
GIRL'S PLAY ROOM
CLOS.
BOY'S PLAY ROOM.
GIRL'S PLAY ROOM.
HEAT
JANITOR'S STORAGE R'M.
BOY'S TOILET R'M.
KINDERGARTEN.
GIRL'S TOILET R'M.

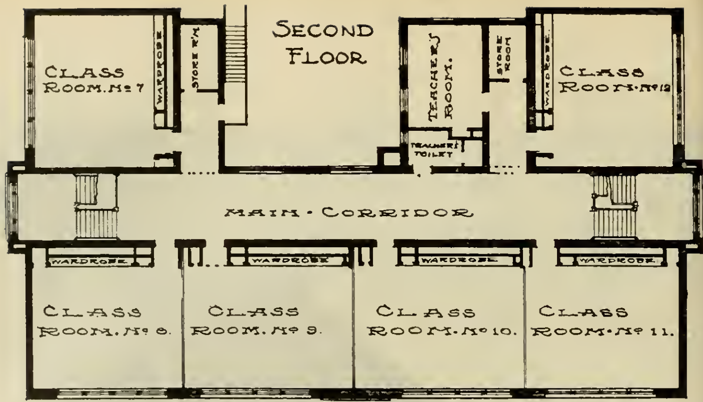
Anthony Wayne School, Philadelphia, Pa., J. Horace Cook, Architect. Cost $170,987=19.3c per cu. ft.

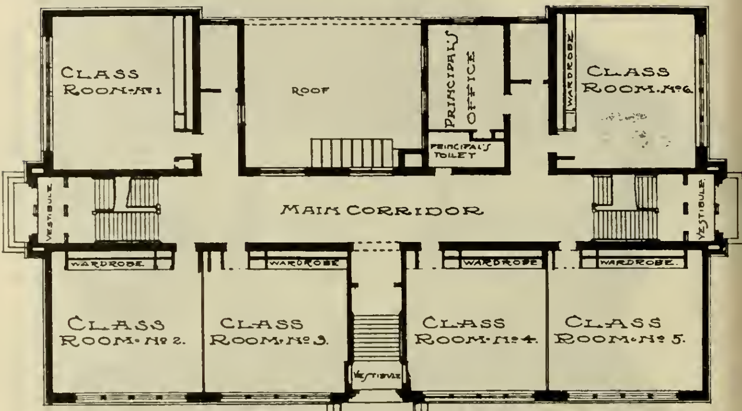

THIRD FLOOR
LADY TEACHER'S ROOM
CLASS ROOM.
STORAGE CLOSET
TEACHER'S TOILET
CORRIDOR
CLASS ROOM.
MEN TEACHER'S ROOM.
TOILET ROOM
GIRLS TOILET ROOM
CLASS ROOM.
CLASS ROOM.
CLASS ROOM
CLASS ROOM.
CLASS ROOM.
CLASS ROOM
CLASS ROOM
GEN. GEO MCCALL SCHOOL PHILADELPHIA.


FIRST FLOOR
TEACHER'S ROOM.
CLASS ROOM.
ROOM
CLASS ROOM
WAIT'G ROOM
PRINCIPAL'S OFFICE
TEACHER'S TOILET
CORRIDOR
PRINCIPAL'S TOILET
CLASS ROOM.
CLASS ROOM.
CLASS ROOM.
CLASS ROOM
CLASS ROOM
CLASS ROOM
CLASS ROOM
GEN GEO. MCCALL SCHOOL. PHILA PENNA


BASEMENT
KINDERGARTER
DOMESTIC SCIENCE
BLOWER AND ENGINE R'M.
BOILER ROOM.
COAL STORAGE
STORAGE ROOM
GIRL'S R
PLAY ROOM.
JANITOR'S TOILET
PLAY ROOM.
GIRLS SHOWERS
BOYS SHOWERS
GIRL'S TOILET.
BOY'S TOILET
GEN GEO MCCALL SCHOOL PHILADELPHIA PA.

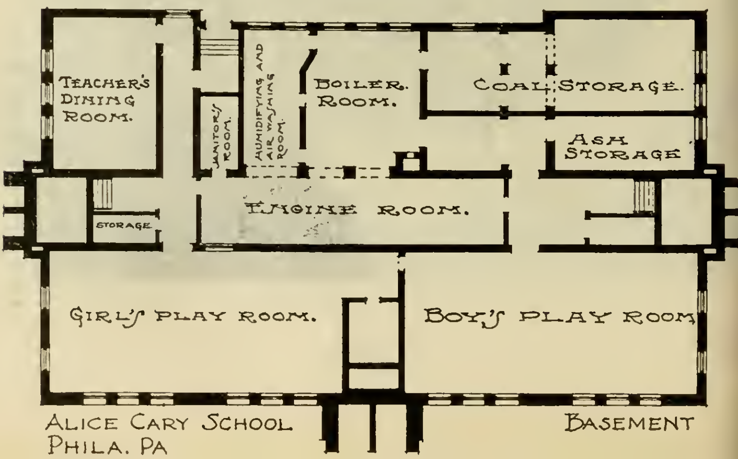
General George McCall School, Philadelphia, Pa. J. Horace Cook, Architect. Cost $200,527=15.9c per cu, ft.





ALICE CARY SCHOOL
PHILA PA.

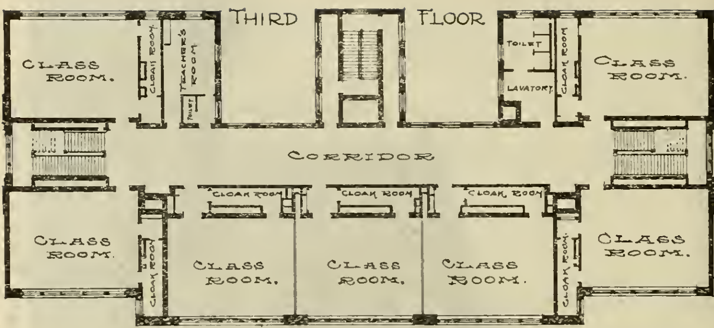
FIRST FLOOR

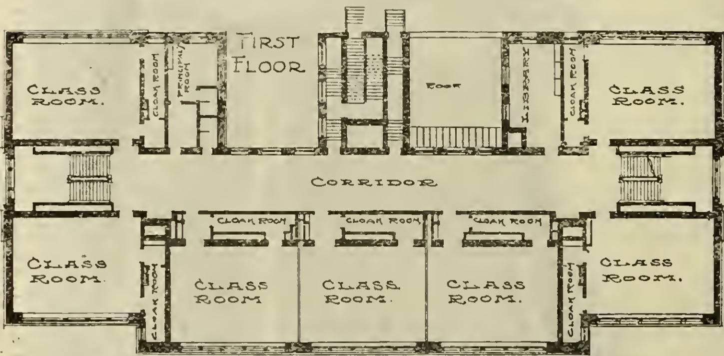


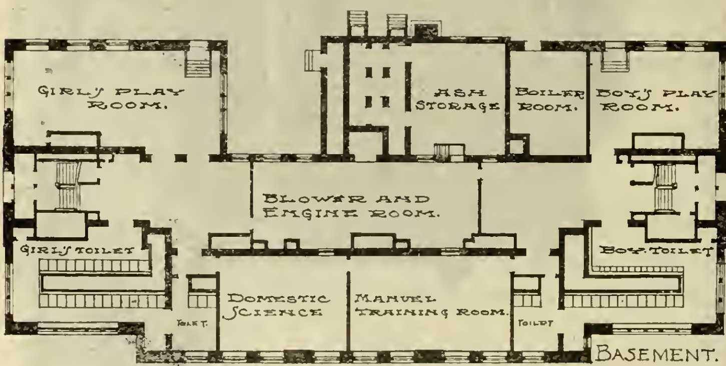
ALICE CARY SCHOOL
PHILA. PA

BASEMENT

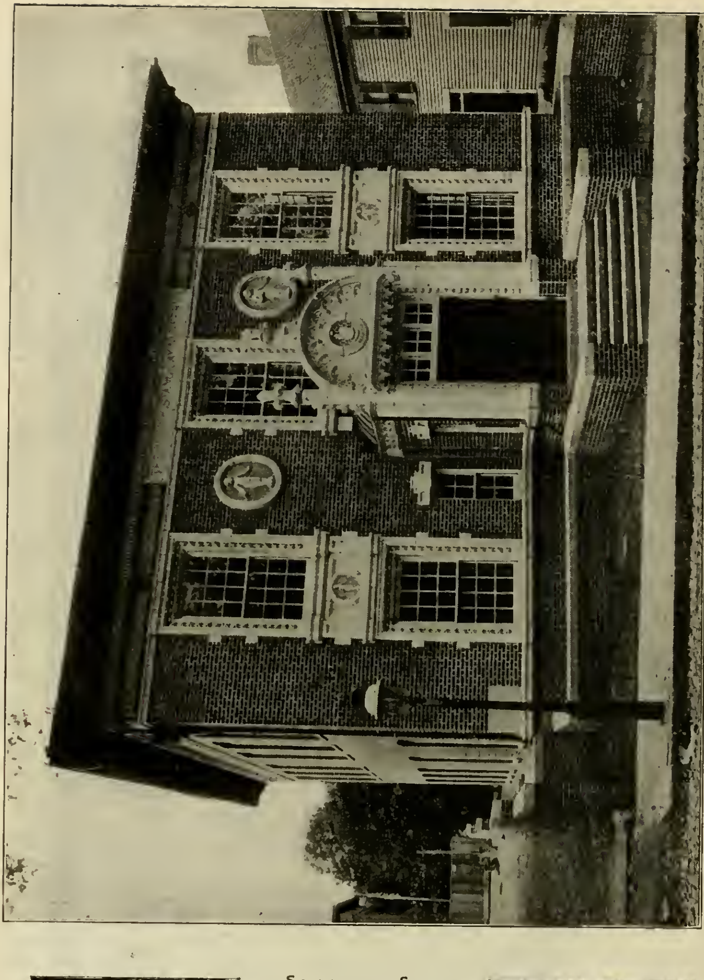
Alice Cary School, Philadelphia, Pa. J. Horace Cook, Architect. H. Courcy Richards, Designer.
Cost $106,620—20.8c per cu. ft.


THIRD FLOOR
CLASS ROOM.
CLOAK ROOM
TEACHER'S ROOM
TOILET
TOILET
LAVATORY
CLOAK ROOM
CLASS ROOM.
CORRIDOR
CLOAK ROOM
CLOAK ROOM
CLOAK ROOM
CLASS ROOM.
CLOAK ROOM
CLASS ROOM.
CLASS ROOM.
CLASS ROOM.
CLOAK ROOM.
CLASS ROOM.

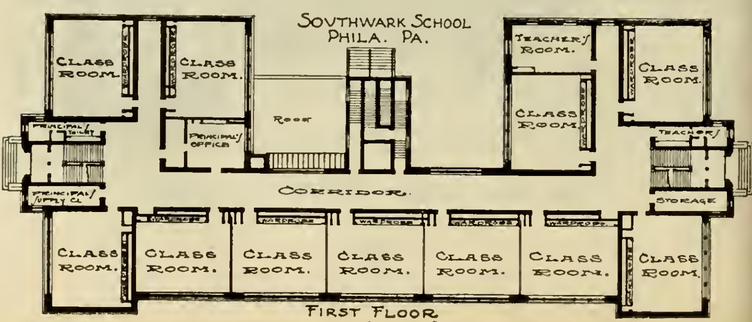

FIRST FLOOR
CLASS ROOM.
CLOAK ROOM
PRINCIPAL'S ROOM
LIBRARY
CLOAK ROOM
CLASS ROOM.
CORRIDOR
CLOAK ROOM
CLOAK ROOM
CLOAK ROOM
CLASS ROOM.
CLOAK ROOM
CLASS ROOM
CLASS ROOM.
CLASS ROOM.
CLOAK ROOM
CLASS ROOM.


GIRL'S PLAY ROOM.
ASH STORAGE
BOILER ROOM.
BOY'S PLAY ROOM.
BLOWER AND ENGINE ROOM.
GIRL'S TOILET
BOY'S TOILET
TOILET
DOMESTIC SCIENCE
MANUEL TRAINING ROOM.
TOILET
BASEMENT.

Frances E. Willard School, Philadelphia, J. Horace Cook, Architect. H. C. Richards, Designer.
Cost $199,860=24.7c per cu. ft.



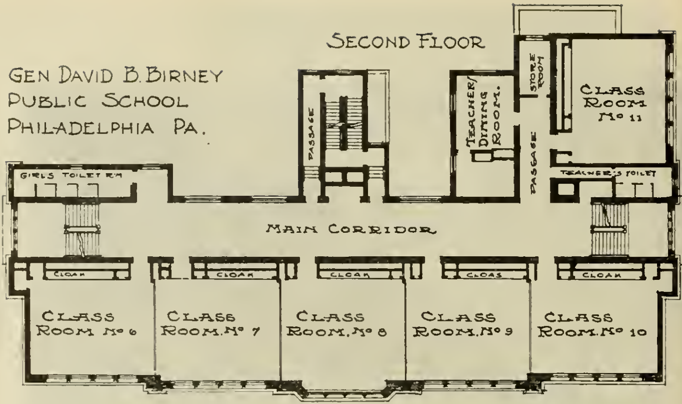
Bishop Stang Day Nursery, Fall River, Mass. Mathew Sullivan, Architect, Boston.



Southwark School, Philadelphia, Pa., J. Horace Cook, Architect. H. Courcy Richards, Designer.
Cost $248,669=17.8c per cu. ft.

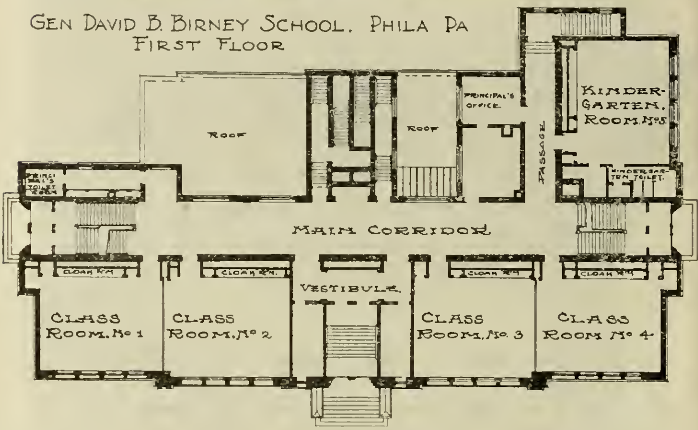
GEN DAVID B. BIRNEY PUBLIC SCHOOL PHILADELPHIA PA.

SECOND FLOOR



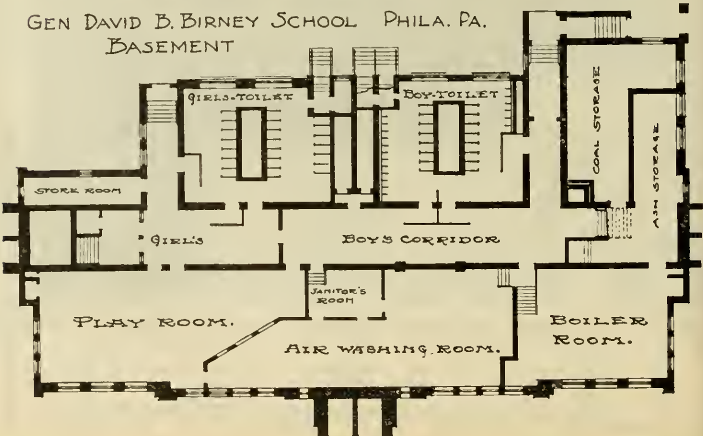
GEN DAVID B. BIRNEY SCHOOL. PHILA PA

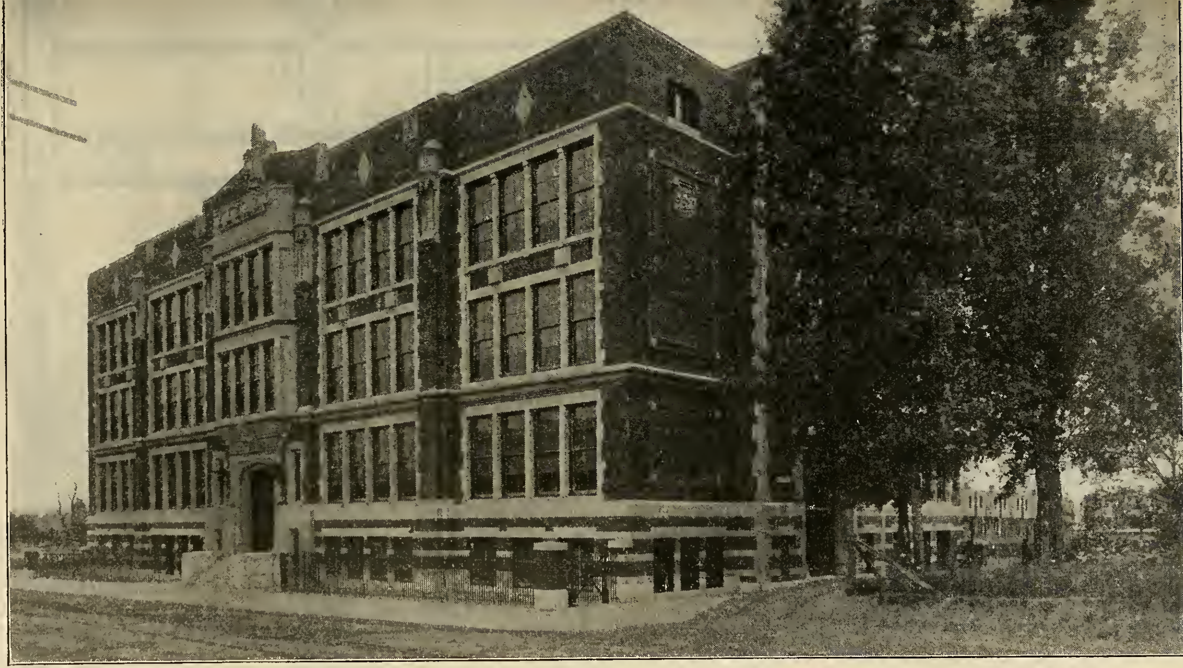
FIRST FLOOR



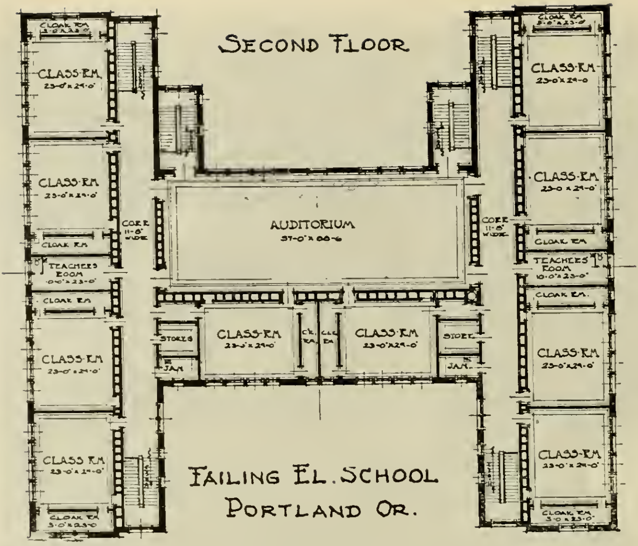
GEN DAVID B. BIRNEY SCHOOL PHILA. PA.

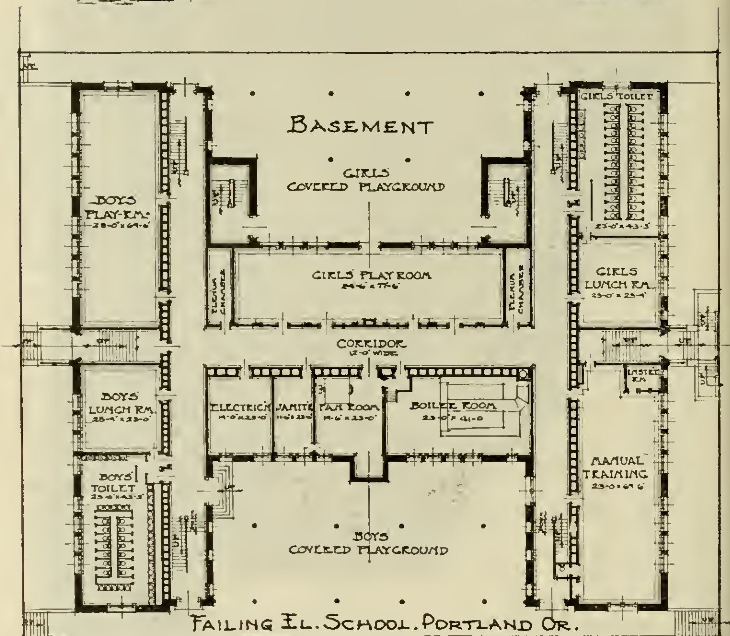
BASEMENT





General David B. Birney School, Philadelphia, Pa. J. Horace Cook, Architect.
Cost $149,388=24.7c per cu. ft.

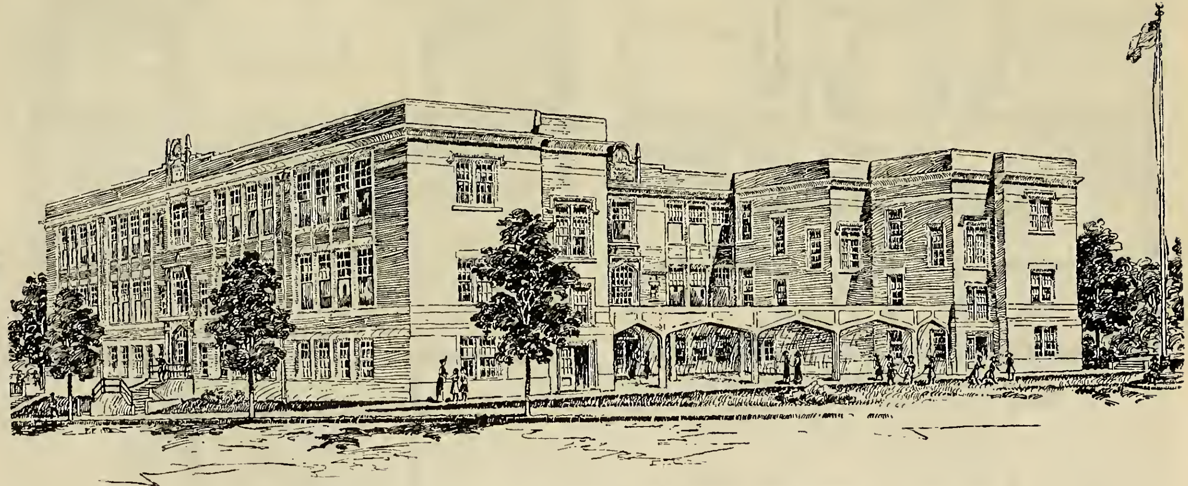




BASEMENT PLAN

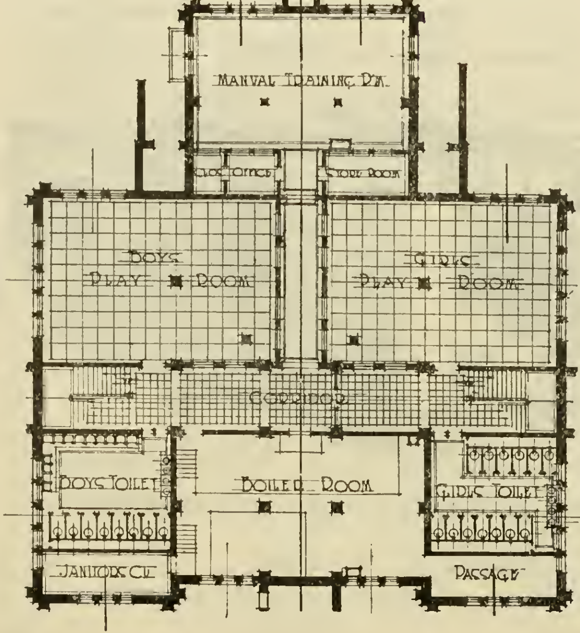
0 5 10 15 20

SCALE IN FEET

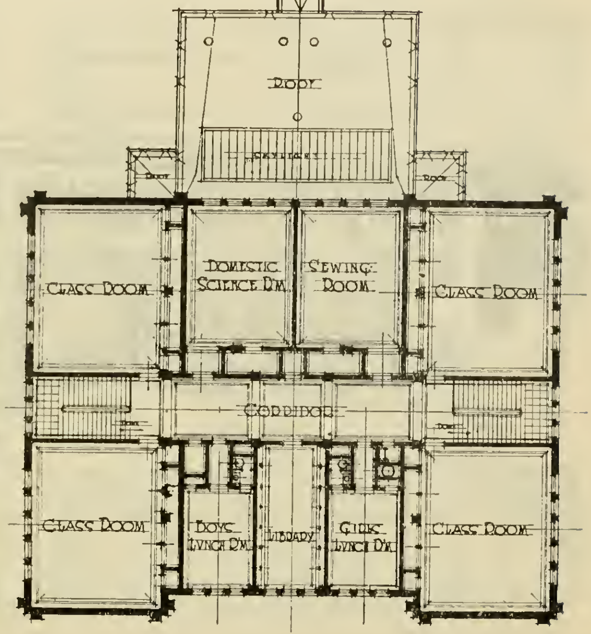


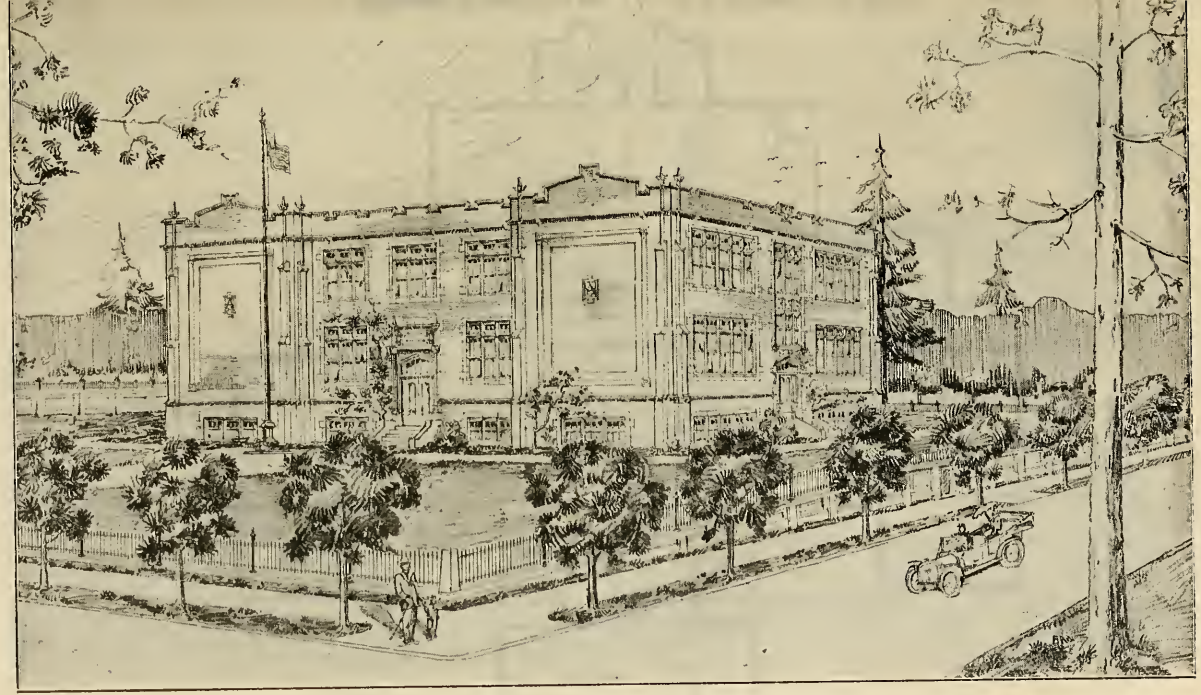
Failing Elementary School, Portland, Ore. Whitehouse and Fauilhoux, Architects.

AINSWORTH EL. SCHOOL GROUND FLOOR

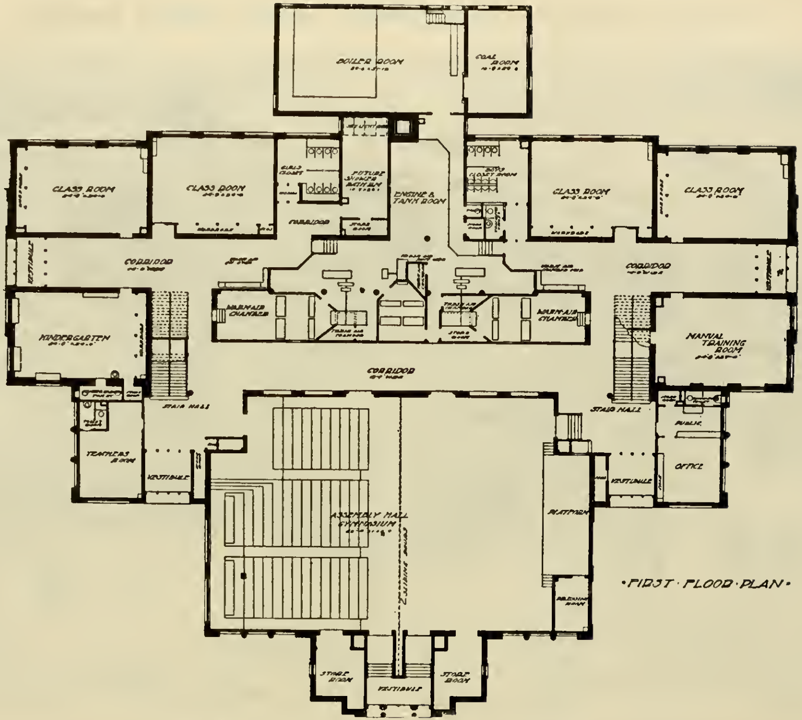


AINSWORTH EL. SCHOOL SECOND FLOOR



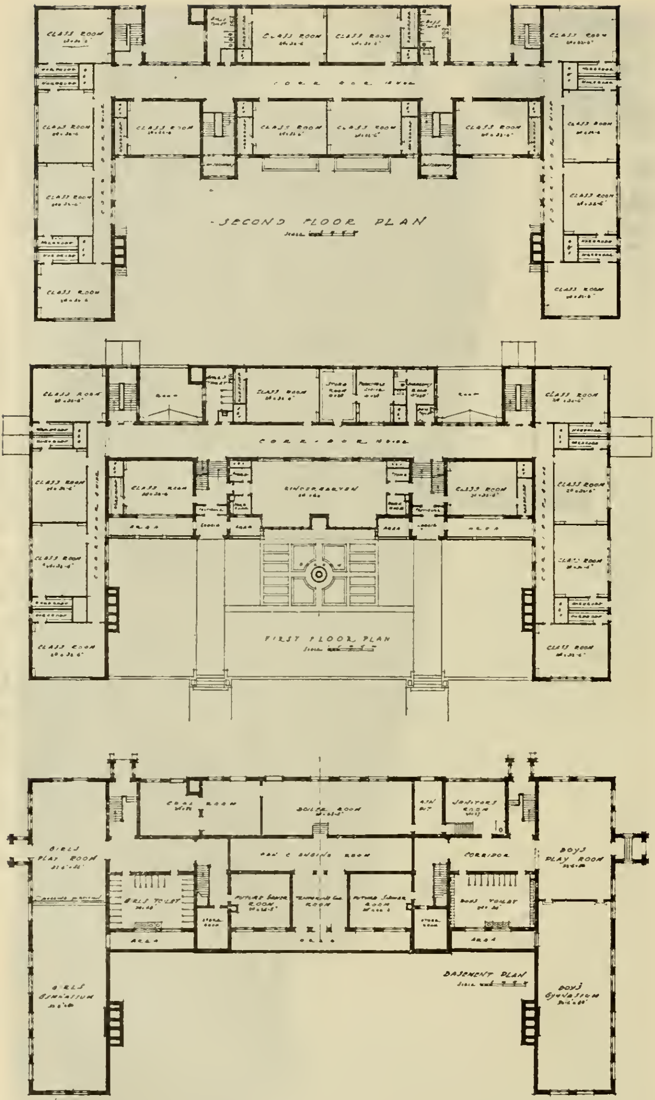


Ainsworth Elementary School, Portland, Ore. F. A. Naramore, Architect.

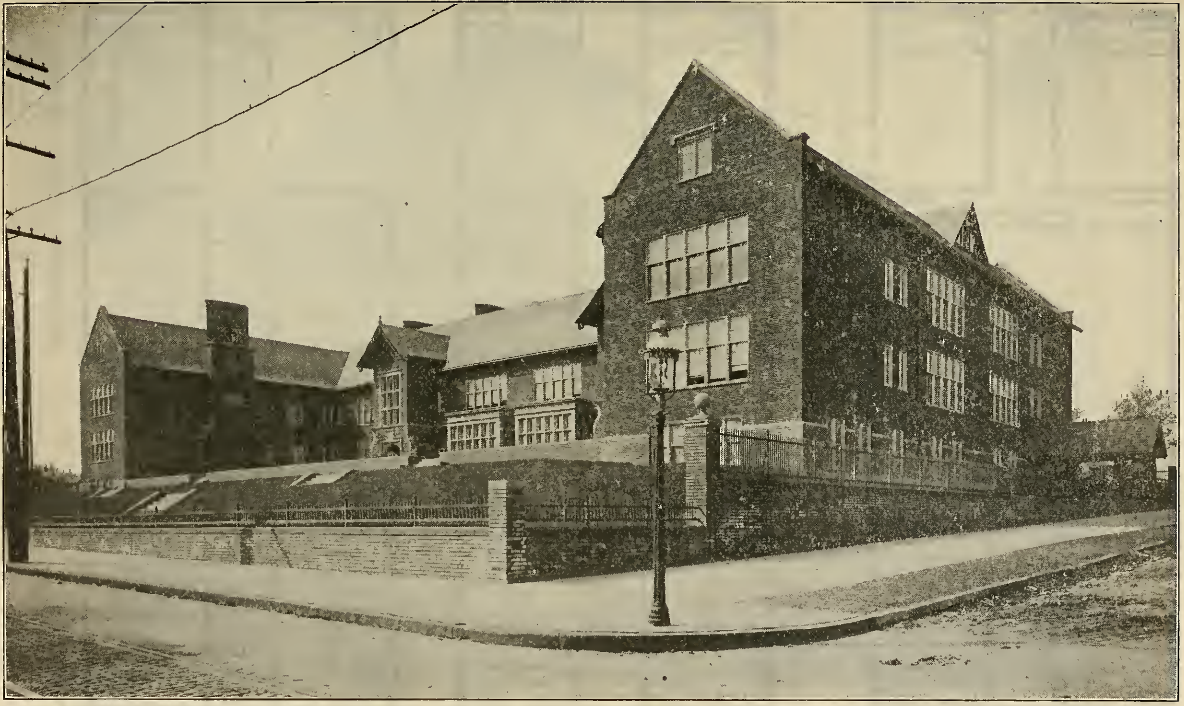


Armstrong School, Chicago, Ill. A. F. Husander, Architect.

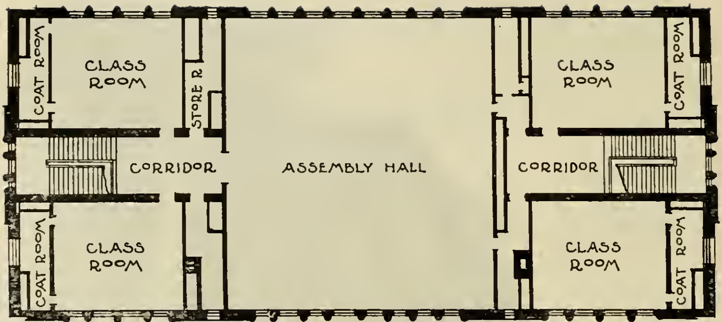
Armstrong School, Chicago, Ill. A. F. Husander, Architect.



Floor Plans, William Glasgow Jr. School. Garrison Ave. and Glasgow Place

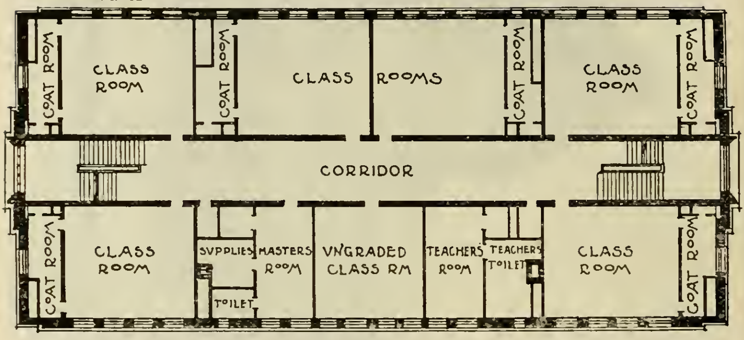


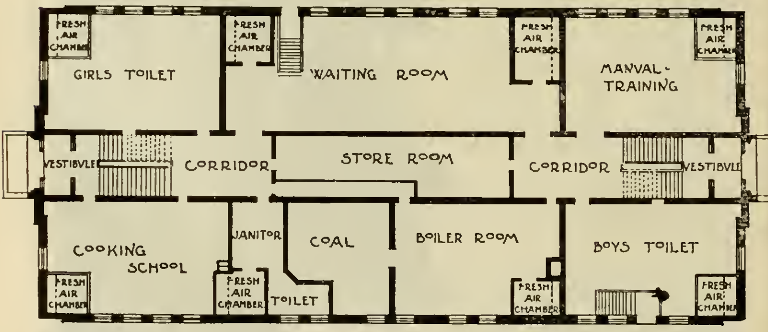
William Glasgow Jr. School, St. Louis, Mo. Wm. B. Ittner, Architect.



THIRD ∘ FLOOR ∘ PLAN ∘

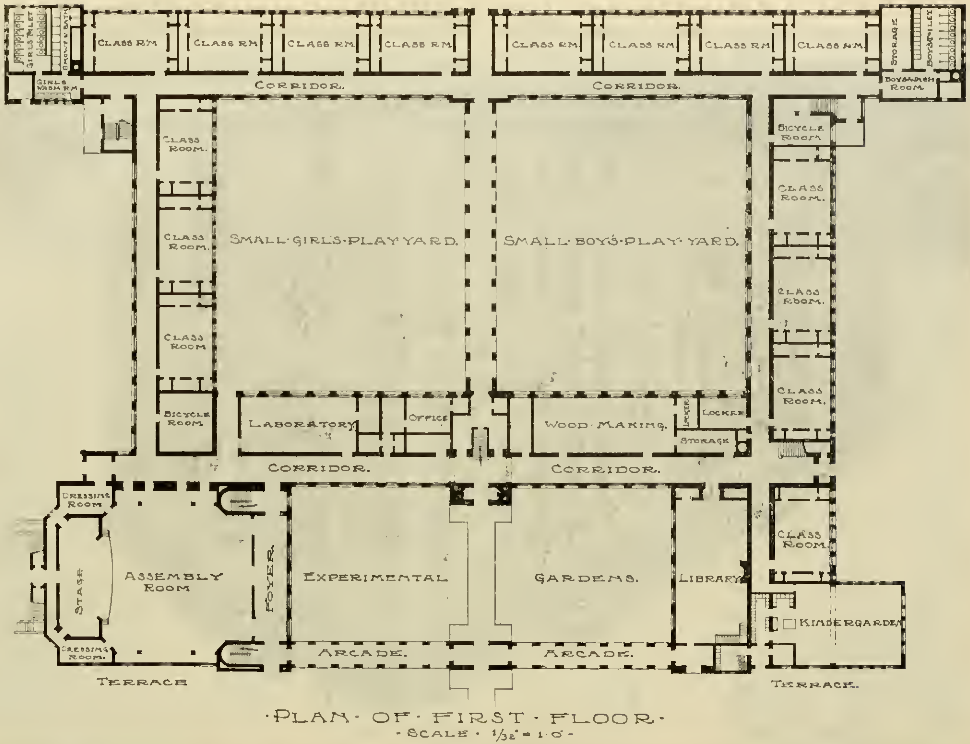
FIRST ∘ FLOOR ∘ PLAN



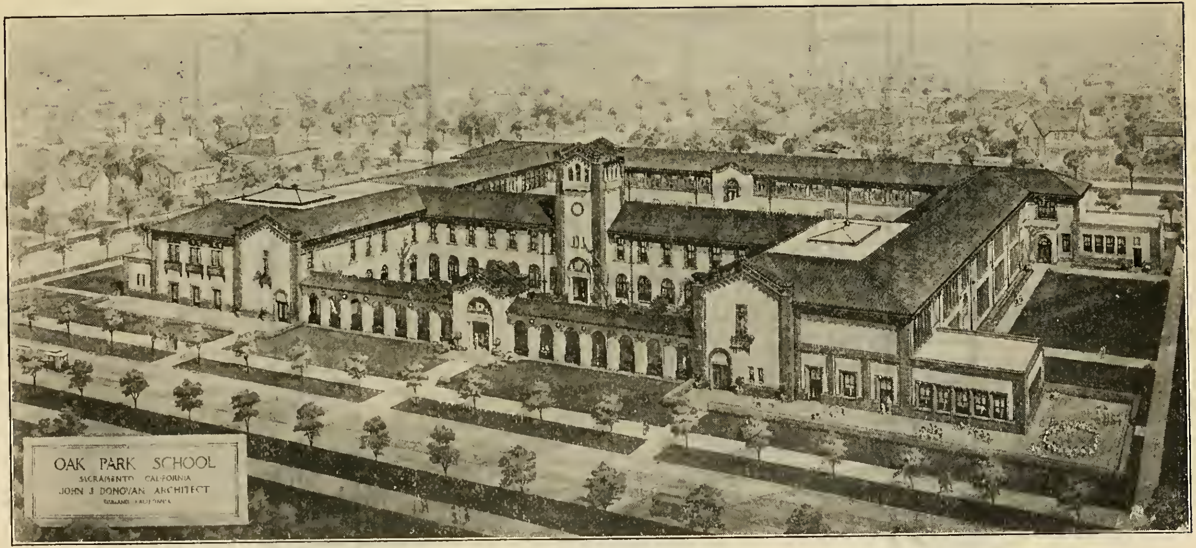


BASEMENT FLOOR PLAN

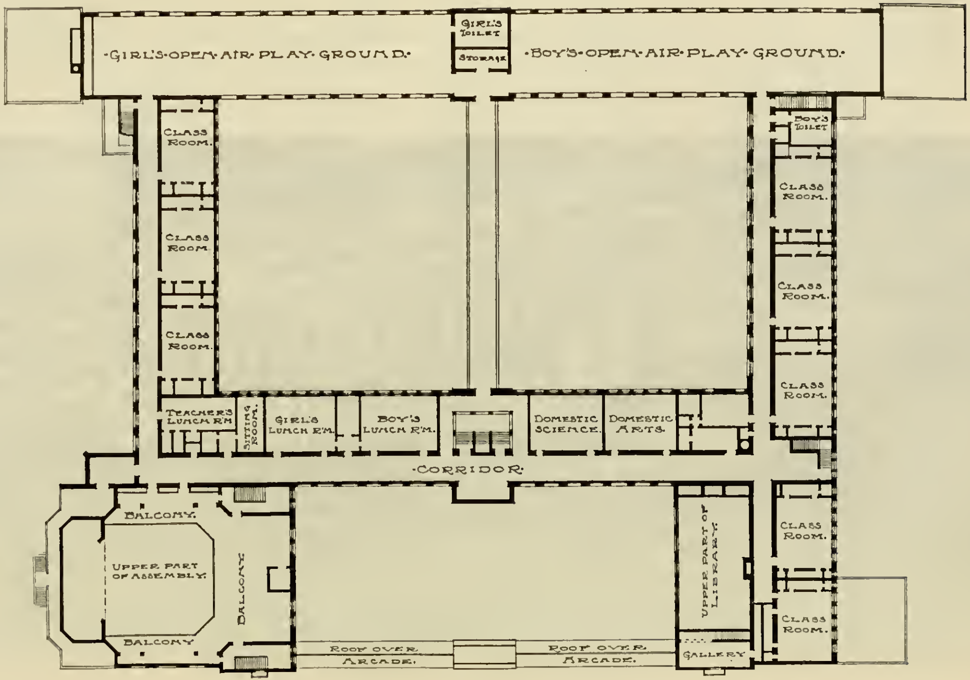
Jefferson School, Roxbury, Mass. Fireproof. Cost 25c per cu. ft. Shepley, Rutan and Coolidge, Architects, Boston.



Oak Park School, Sacramento, Cal.

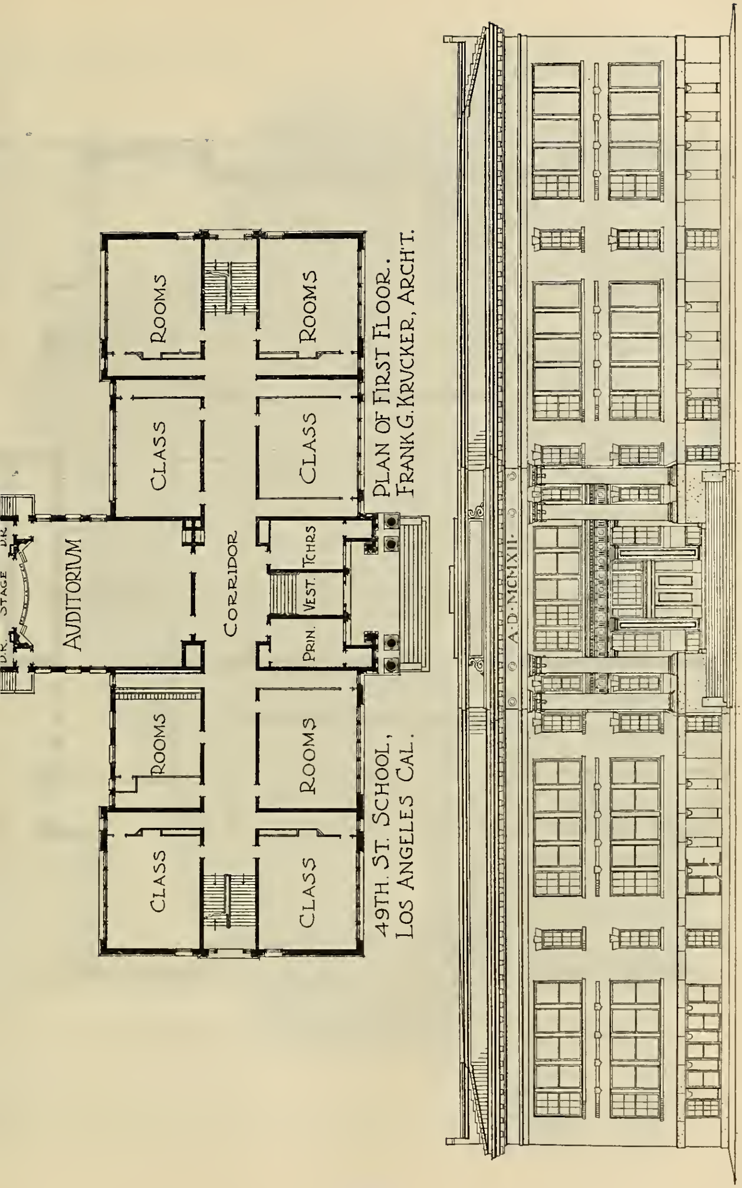


Oak Park School, Sacramento, Calif. John J. Donovan, Architect, Oakland, Cal.



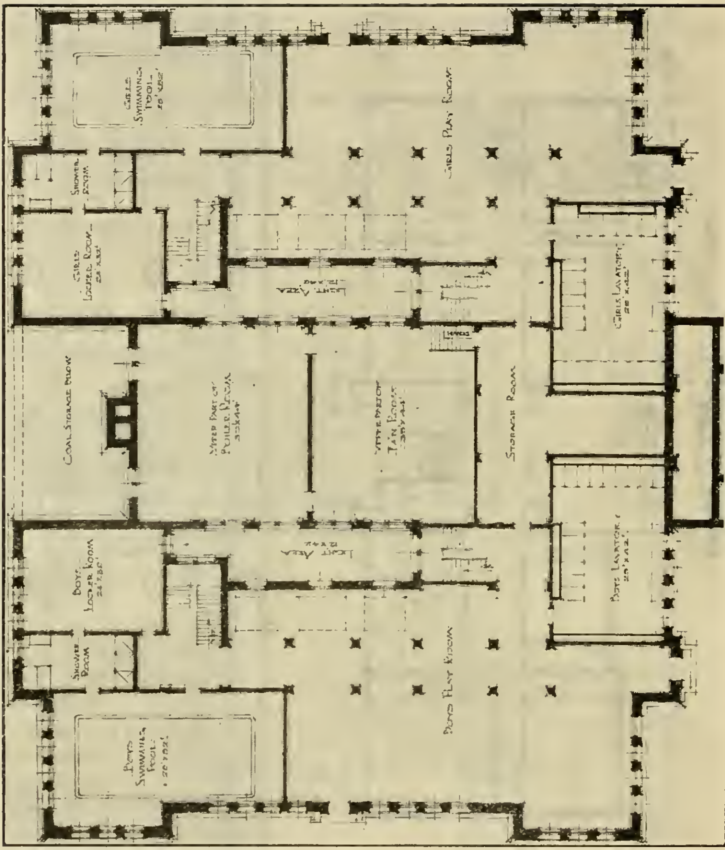
·PLAN·OF·SECOND·FLOOR·
·SCALE $1/32$" = 1'-0"·

Oak Park School, Sacramento, Cal.



49TH. ST. SCHOOL, LOS ANGELES CAL.

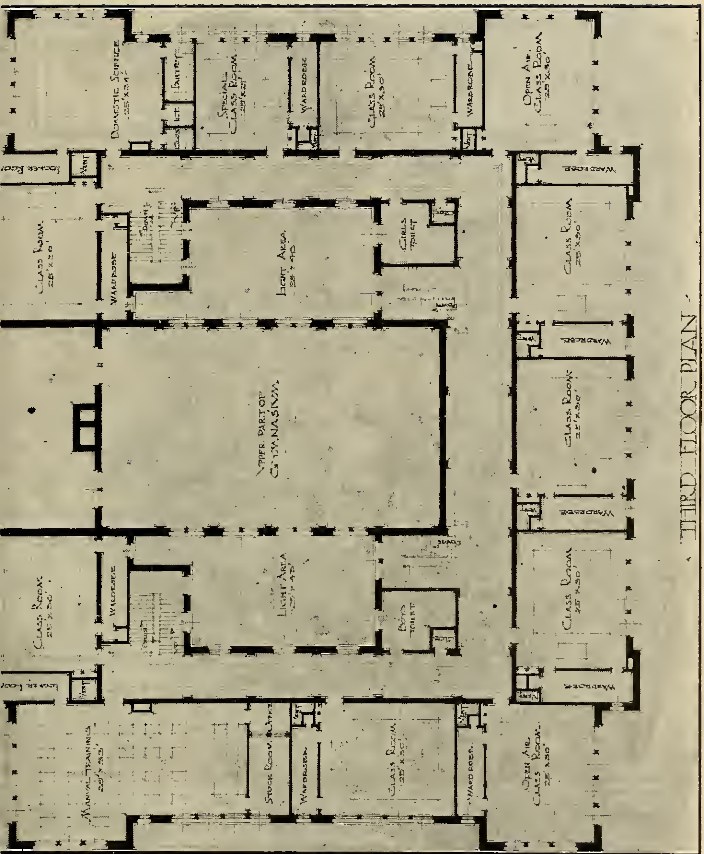
PLAN OF FIRST FLOOR. FRANK G. KRUCKER, ARCH'T.



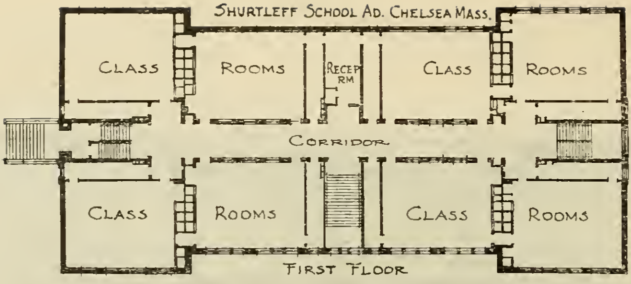
Basement Plan, George Sands School, Cincinnati, O.

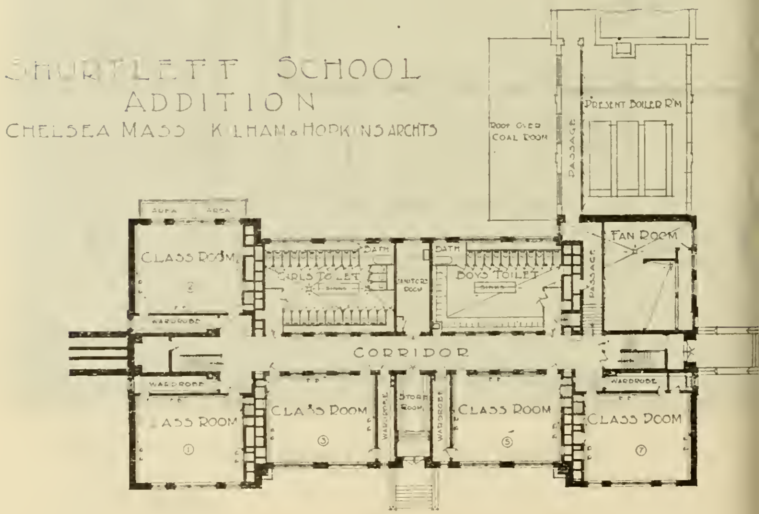
George Sands School, Cincinnati, O. Tietig and Lee, Architects. Note roof play ground and open air school rooms, top floor. Fireproof. Cost $270,000=16c per cubic foot.

First Floor Plan, George Sands School, Cincinnati, Ohio.

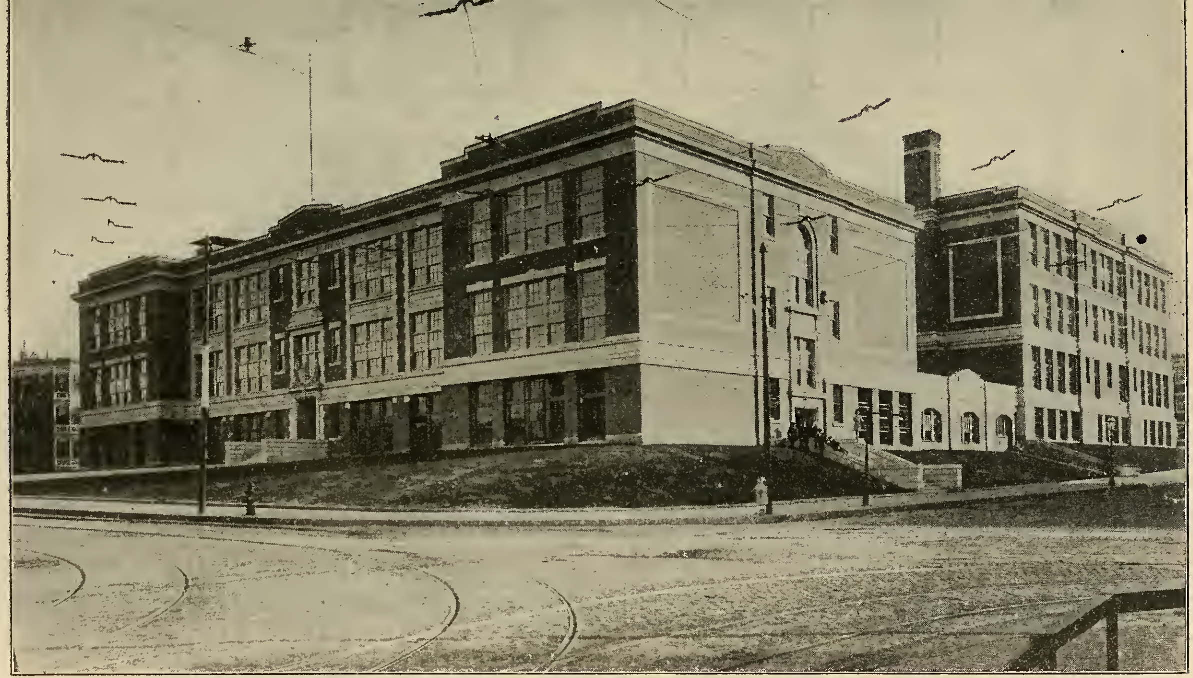


George Sands School, Cincinnati, O.

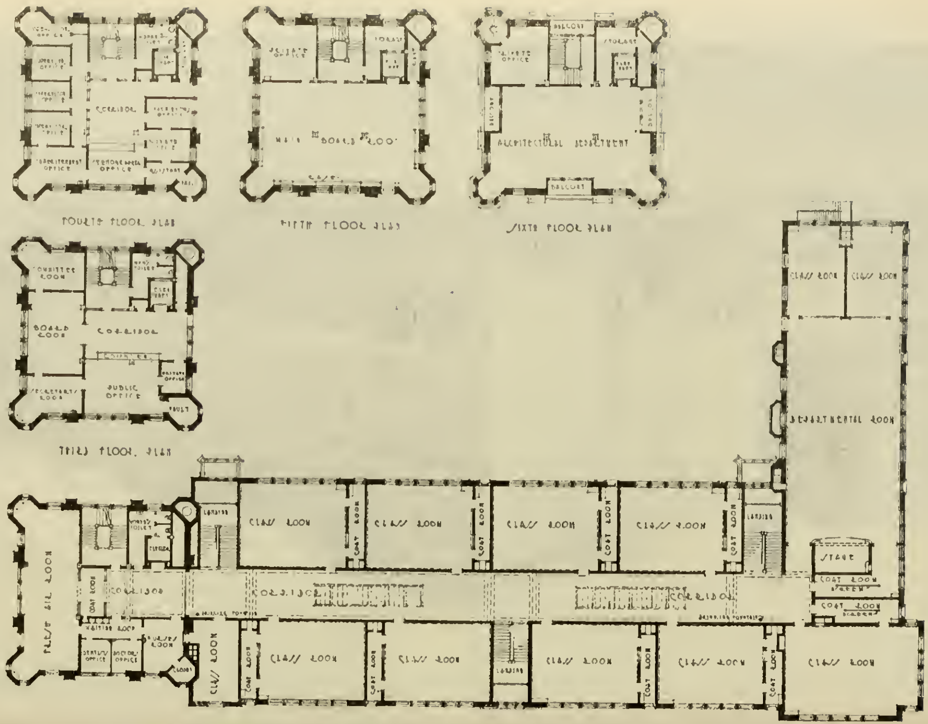




BASEMENT PLAN

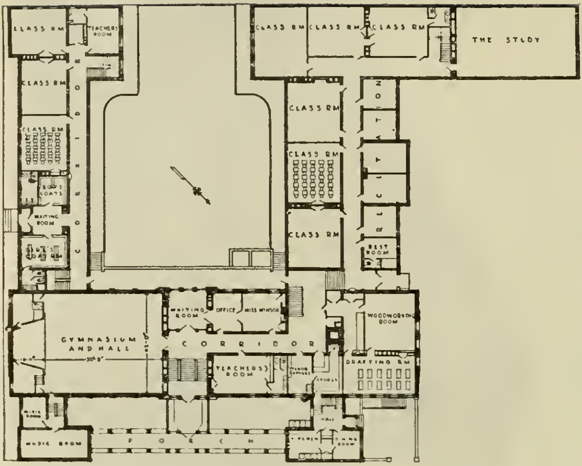


Addition, Shurtleff School, Chelsea, Mass. Kilham & Hopkins, Architects, Boston.

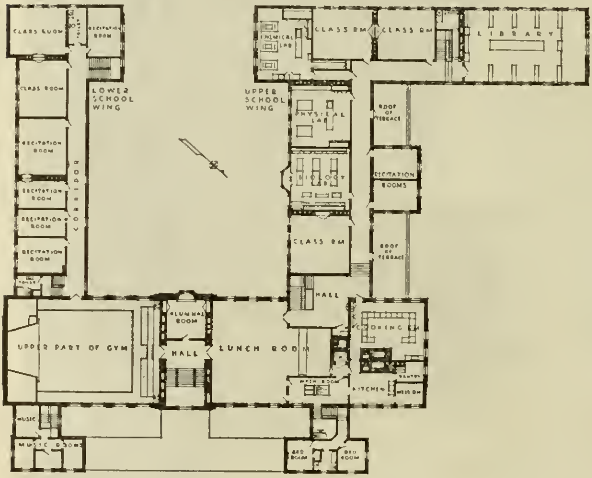


Central School, Tacoma, Wash., Heath & Gove, Architects, Tacoma.

Central School, Tacoma, Wash. Heath & Gove, Architects, Tacoma.
Tower fireproof. Remainder slow burning construction. Cost 14c per cu. ft.



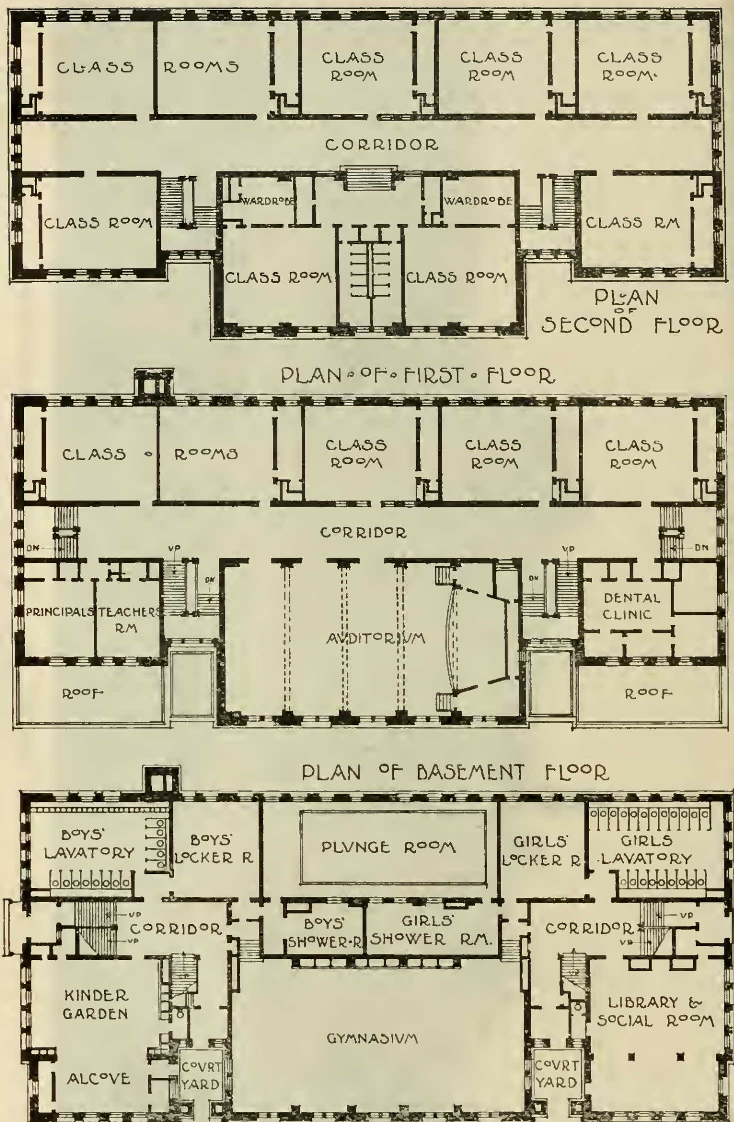
FIRST FLOOR PLAN



SECOND FLOOR PLAN

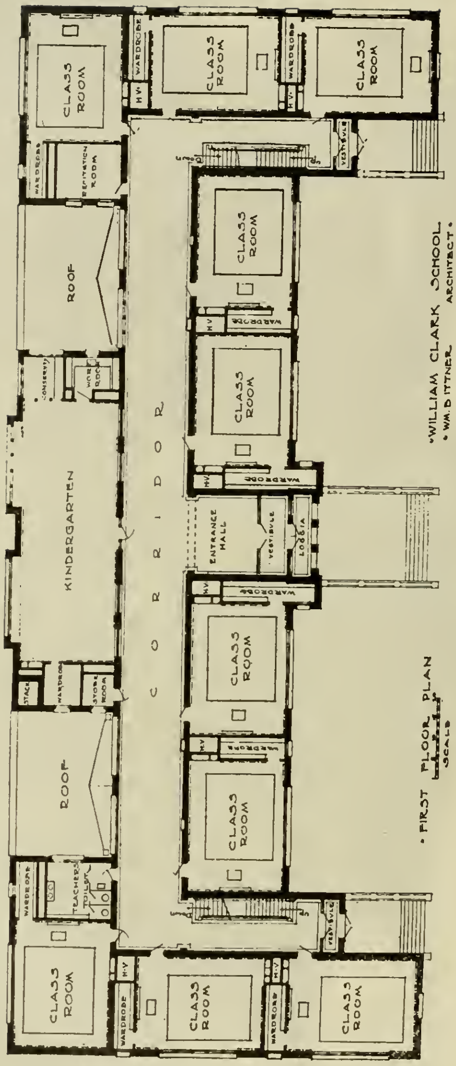
Winsor School, Brookline, Mass., R. Clipston Sturgis, Architect, Boston.

Winsor School, Brookline, Mass. R. Clipston Sturgis, Architect, Boston.
Cost $176,443=23.5c per cu. ft.

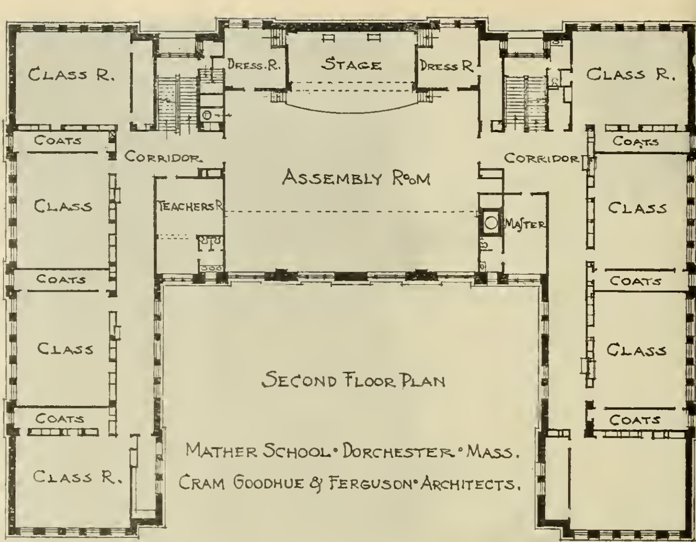


Guilford School, Cincinnati, O.

Guilford Public School, Cincinnati, O. Garber & Woodward, Architects.

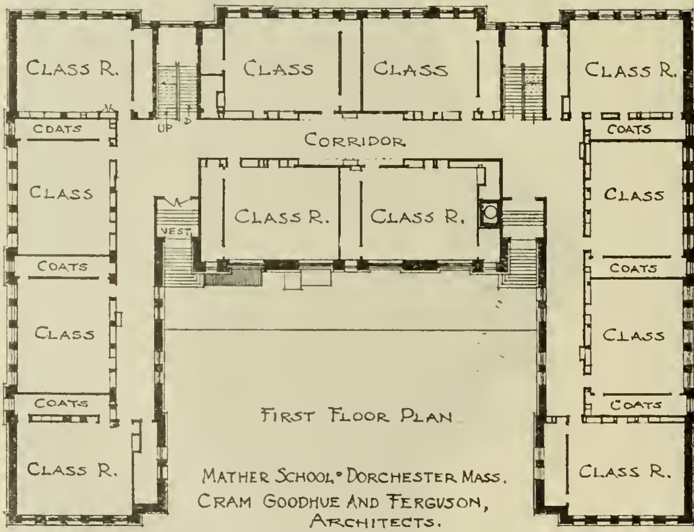

CLASS ROOM
WARDROBE
H.V.
RECITATION ROOM
ROOF
CONSERV'Y
WORK ROOM
KINDERGARTEN
STACK
STORE ROOM
TEACHERS TOILET
CORRIDOR
ENTRANCE HALL
VESTIBULE
LOGGIA
• FIRST FLOOR PLAN
SCALE
• WILLIAM CLARK SCHOOL
• WM. B. ITTNER ARCHITECT •

William Clark School, St. Louis, Mo. Wm. B. Ittner, Architect.



SECOND FLOOR PLAN

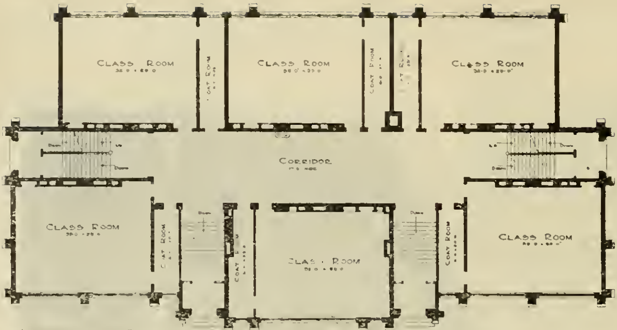
MATHER SCHOOL · DORCHESTER · MASS.
CRAM GOODHUE & FERGUSON · ARCHITECTS.



FIRST FLOOR PLAN

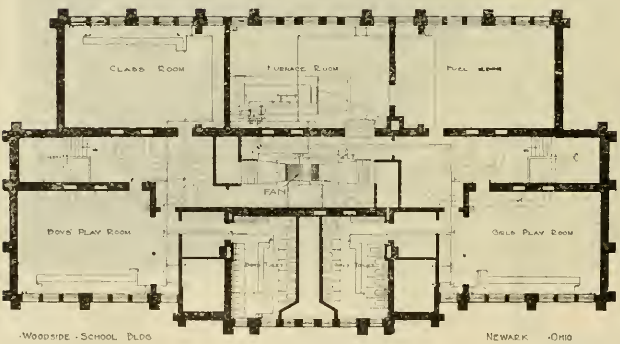
MATHER SCHOOL · DORCHESTER MASS.
CRAM GOODHUE AND FERGUSON,
ARCHITECTS.

Mather School, Dorchester, Mass. Cram, Goodhue and Ferguson, Architects, Boston.



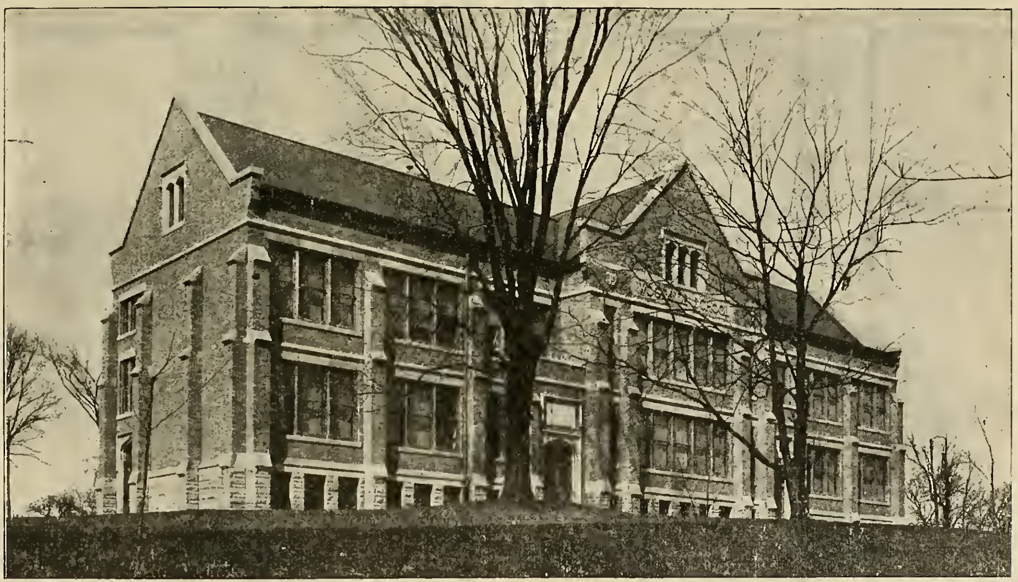
WOODSIDE SCH. BLDG. NEWARK · OHIO

FIRST FLOOR PLAN

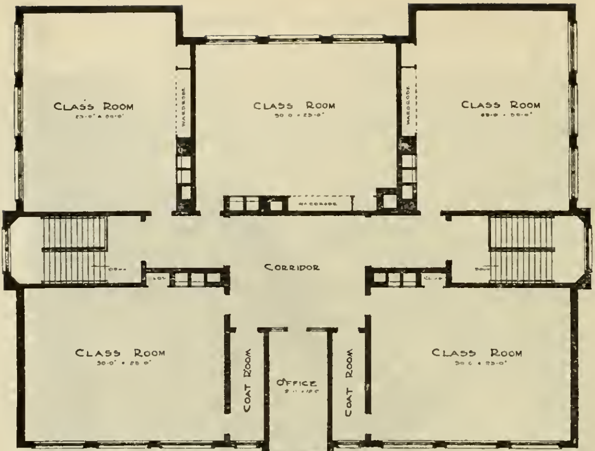


·WOODSIDE · SCHOOL BLDG NEWARK · OHIO

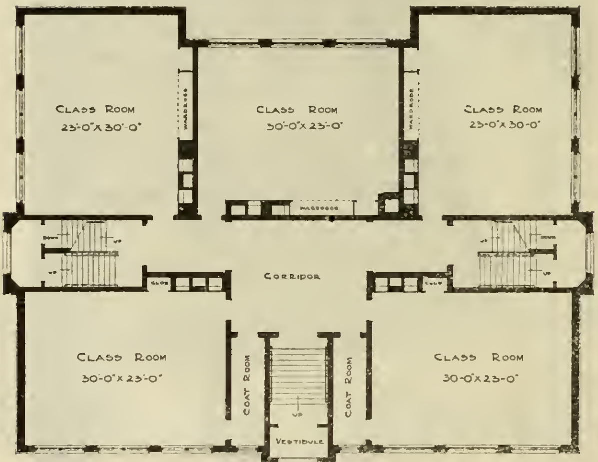
BASEMENT FLOOR PLAN



Woodside School Building, Newark, O. Wilbur T. Mills, Architect, Columbus, O. Cost 13c cu. ft.

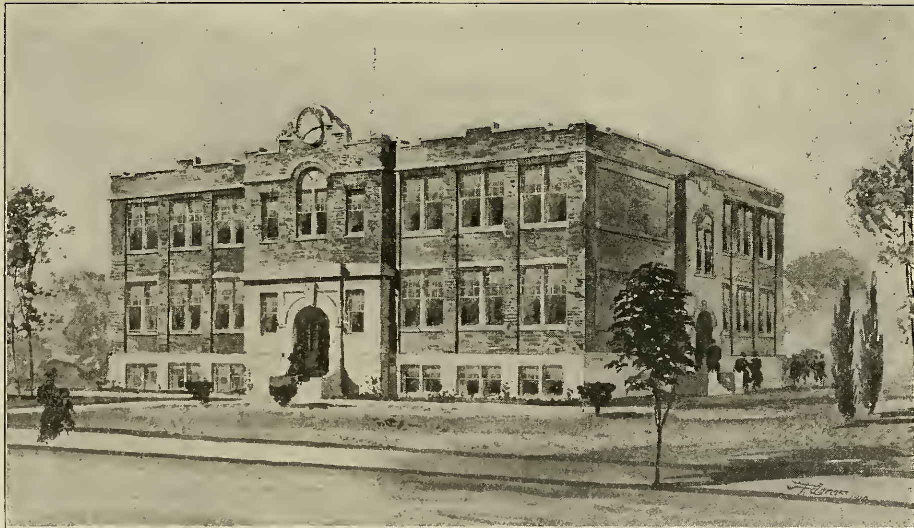


SECOND FLOOR PLAN



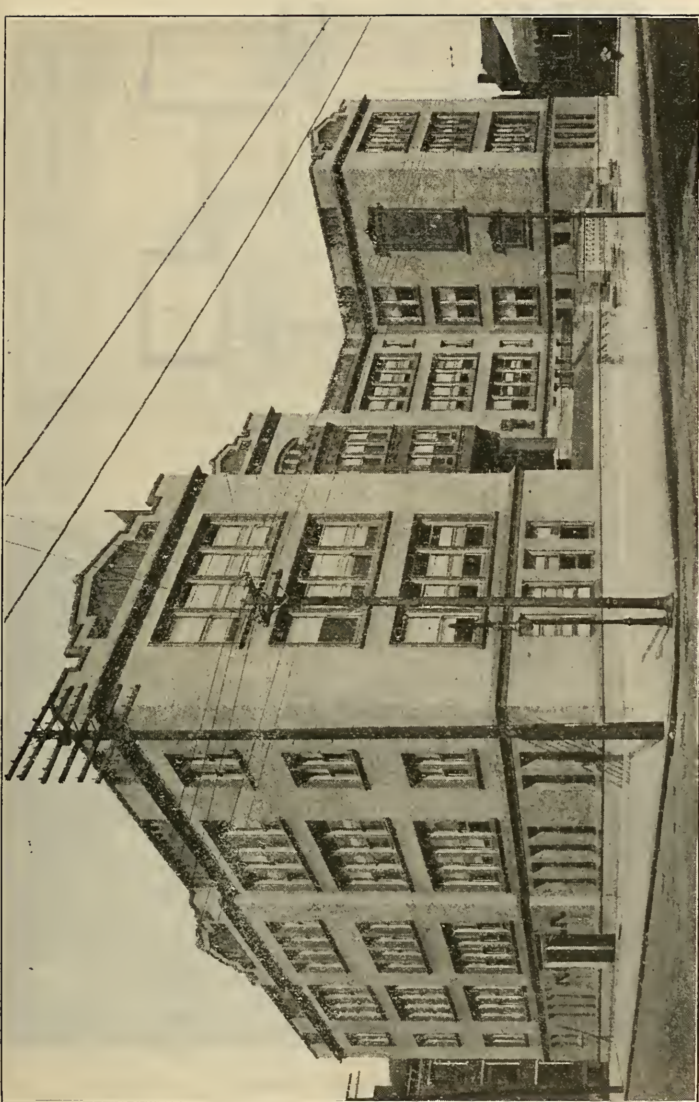
FIRST FLOOR PLAN

$30,000. Fireproof School Building.

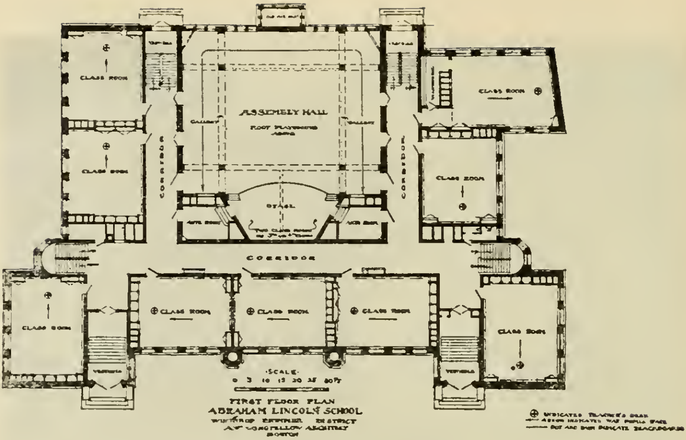


A model ten room fireproof school building which can be built for a minimum of $30,000.

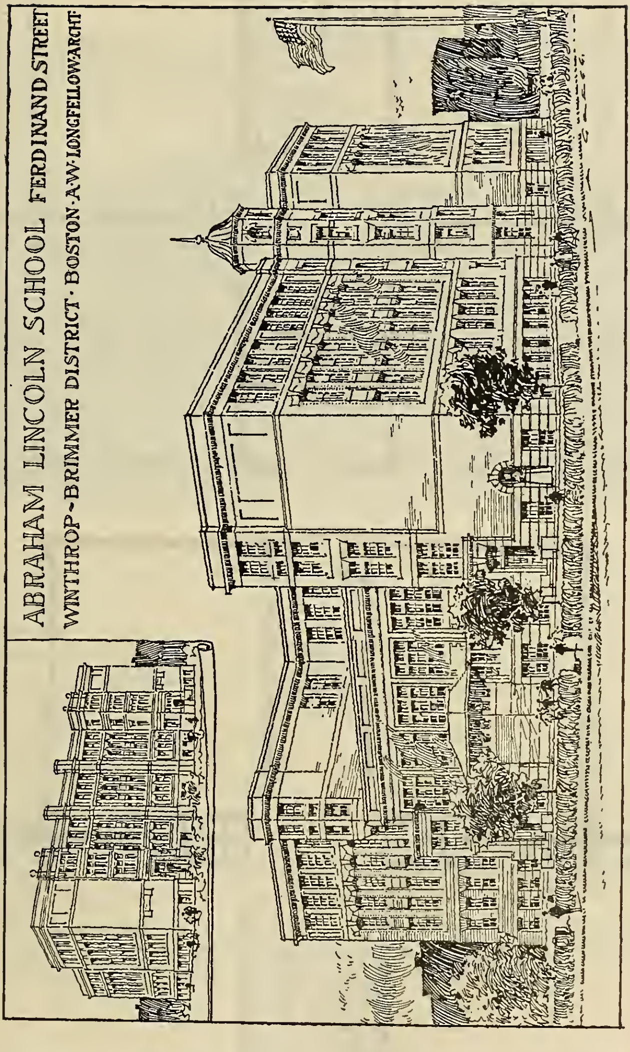
Marshall School, Dorchester, Mass. Maginnis, Walsh and Sullivan, Architects, Boston.

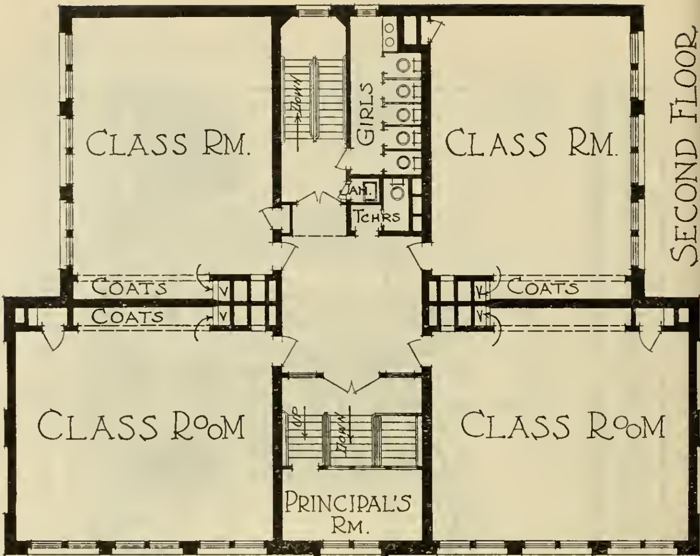


Eleventh District School, Cincinnati, O. E. H. Dornette, Architect.

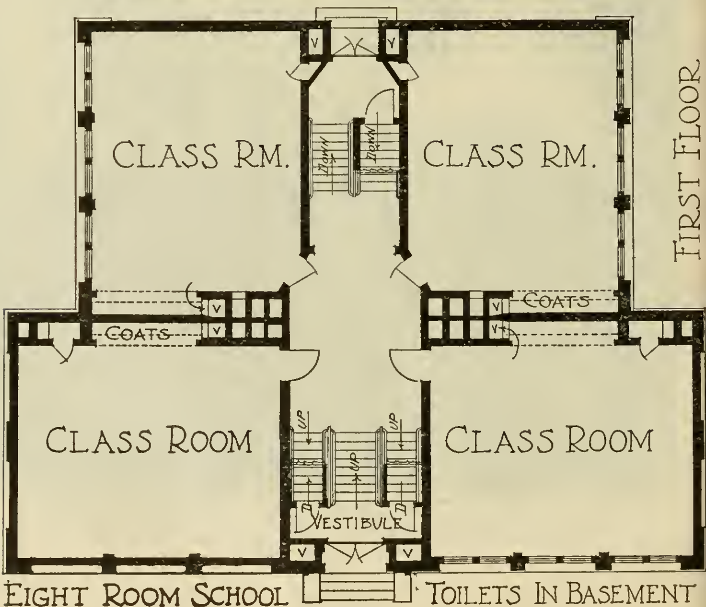


Fredonia High School. Chas. A. Dieman & Co., Architects,
Cedar Rapids, Ia.

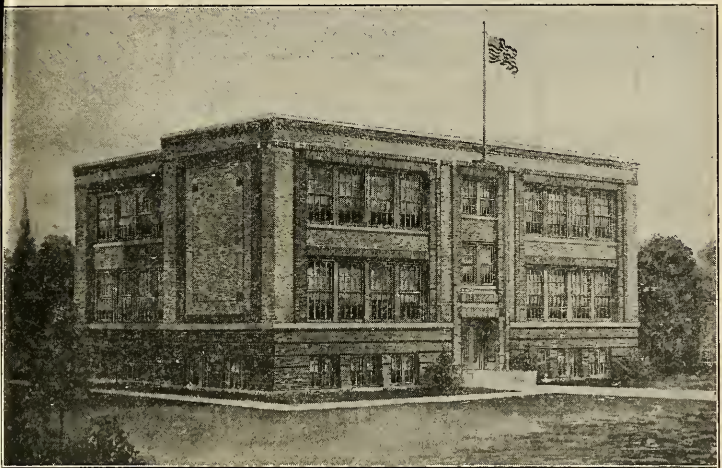

ABRAHAM LINCOLN SCHOOL FERDINAND STREET
WINTHROP-BRIMMER DISTRICT · BOSTON · A·W·LONGFELLOW·ARCHT



EIGHT ROOM SCHOOL WITH TOILETS ON EACH FLOOR



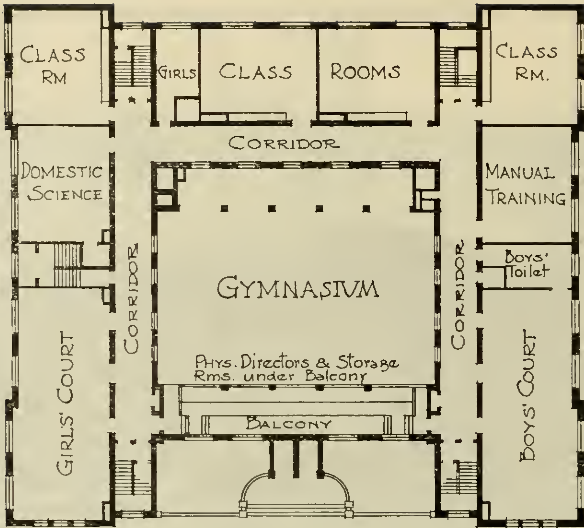
EIGHT ROOM SCHOOL · TOILETS IN BASEMENT



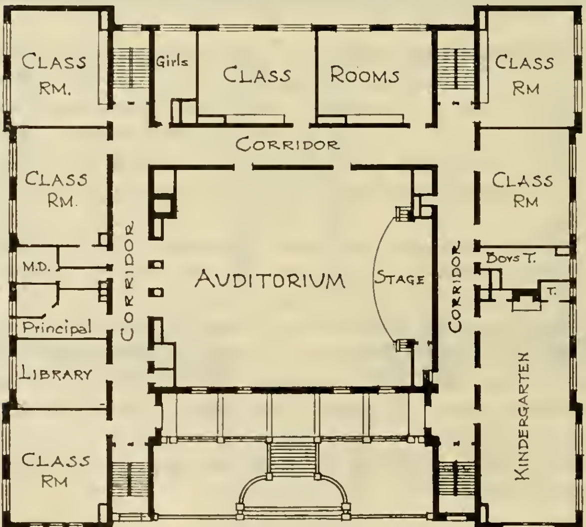
The very rigid requirements of the Ohio Code have given birth to a plain type of fireproof school buildings, very compact and very economical. On account of cost, it is necessary to omit costly ornament and elaborate design of every sort. The many colored and different texture brick now generally in use are made use of to produce interesting color effects and thus in some measure make up for other more expensive forms of decoration.

The above building is shown as an illustration of one of the most successful buildings of this type, being an eight room fireproof structure above basement, and having two finished rooms in basement, of same height as the school rooms, serviceable for laboratories, manual training, etc.

Where necessary for the sake of economy, the toilets are all located in basement. Where more money is available, toilets are arranged on the floors with the school rooms. On opposite page plans are shown illustrating both of these arrangements. An eight room school building of this type may be built for as little as $20,000.00 and in no case need exceed $30,000.00, at prices now existing, (1915).



·BASEMENT PLAN·

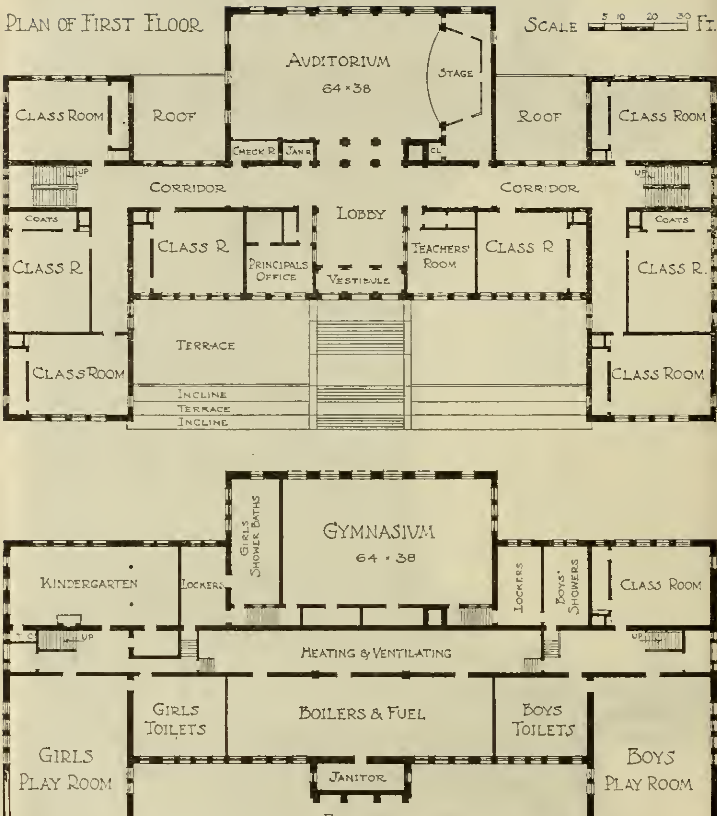


FIRST FLOOR PLAN · SCALE 10 20 30 40 FT.

CLEVELAND SCHOOL · NEWARK · NEW JERSEY

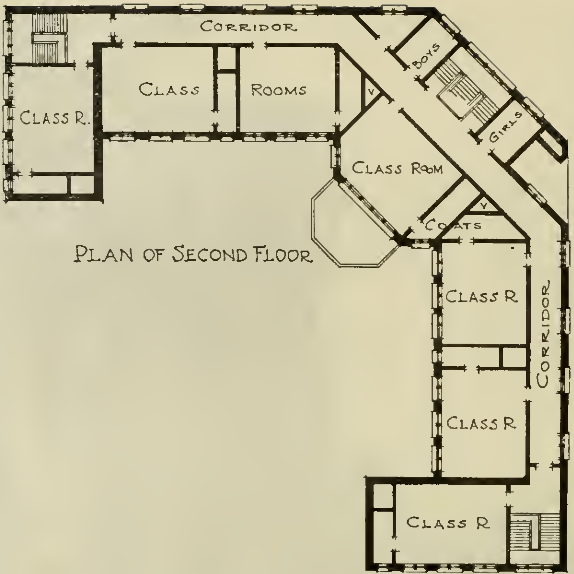
· E. F. GUILBERT · ARCHITECT ·

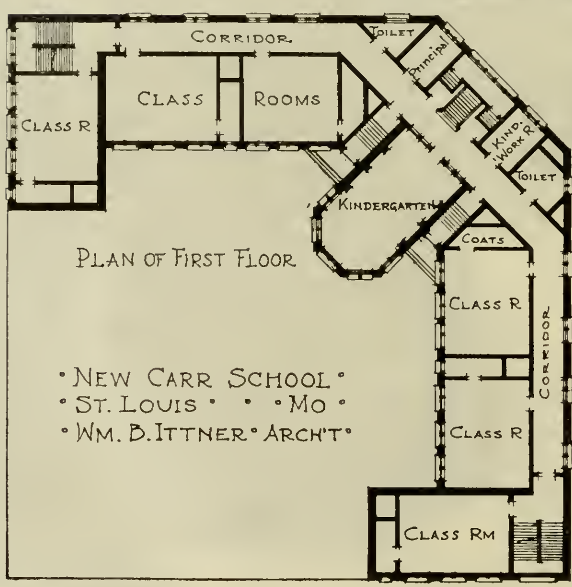
Cleveland School, Newark, New Jersey. E. F. Guilbert, Arc hitect. 37 class rooms. Auditorium seats 830. Cost $245,000.



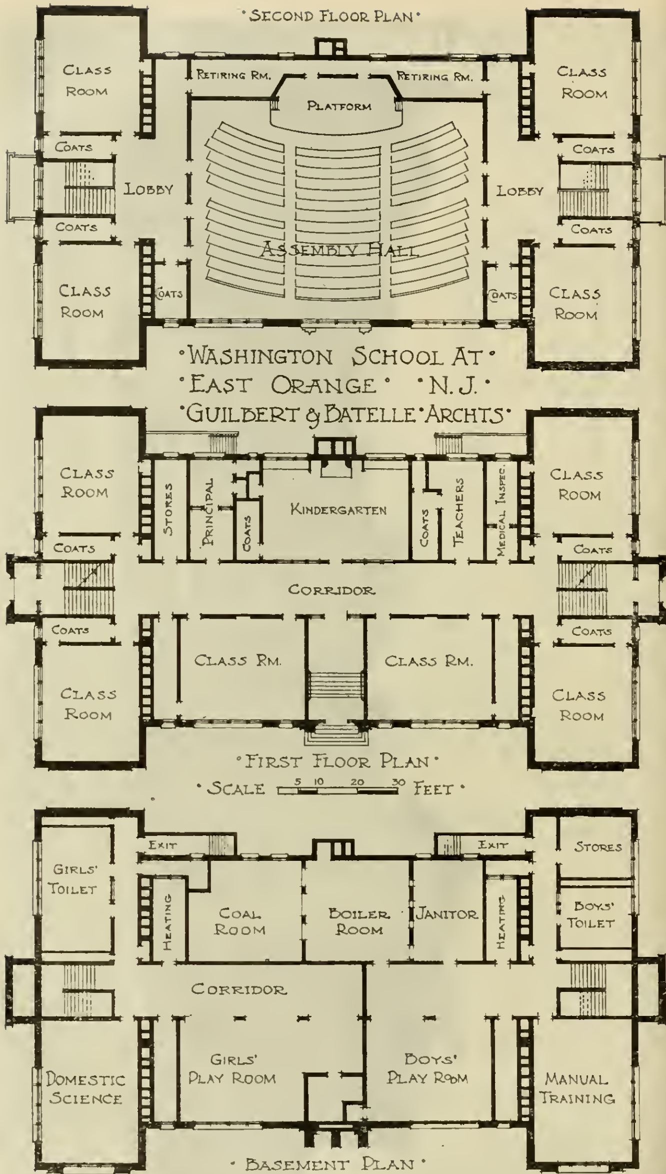
WESTWOOD SCHOOL
CINCINNATI OHIO

Westwood School, Cincinnati, O. Garber & Woodward, Architects.

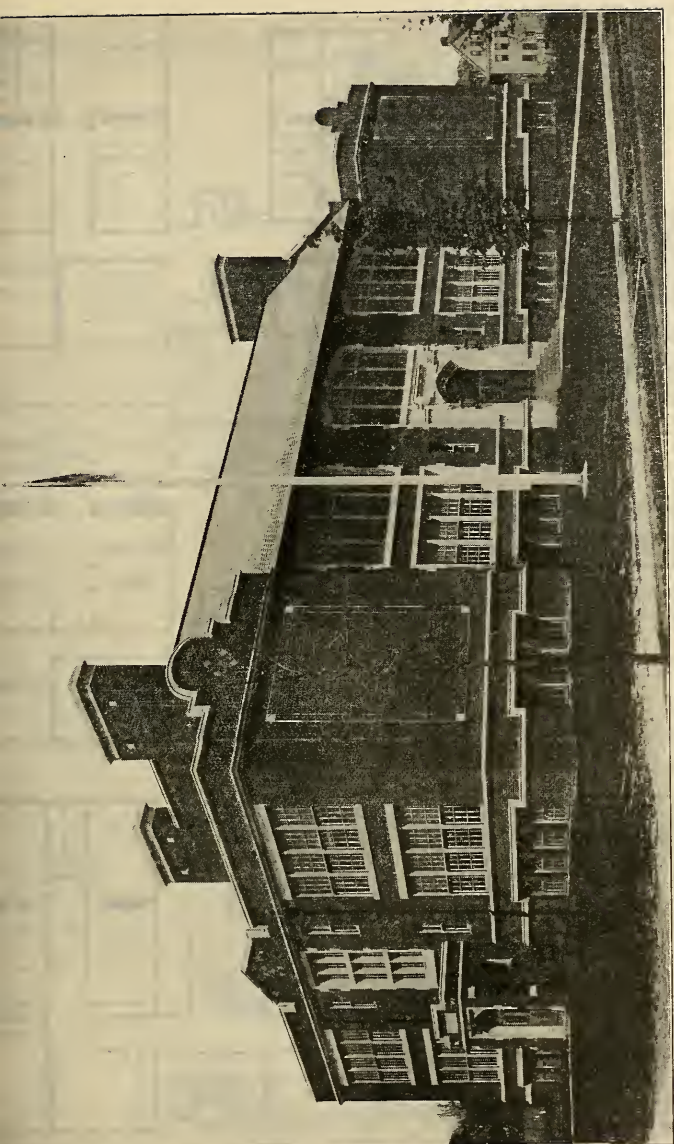

CORRIDOR
CLASS
ROOMS
CLASS R.
V
BOYS
GIRLS
CLASS ROOM
V
COATS
PLAN OF SECOND FLOOR
CLASS R
CORRIDOR
CLASS R
CLASS R


CORRIDOR
TOILET
Principal
CLASS
ROOMS
CLASS R
KIND. WORK R
TOILET
KINDERGARTEN
COATS
PLAN OF FIRST FLOOR
CLASS R
CORRIDOR
• NEW CARR SCHOOL •
• ST. LOUIS • • MO •
• WM. B. ITTNER • ARCH'T •
CLASS R
CLASS RM

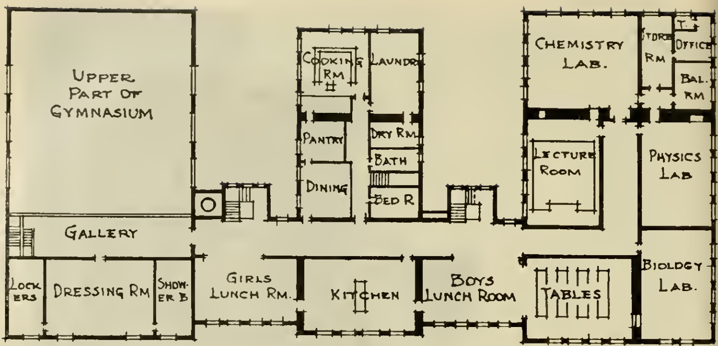
New Carr School, St. Louis, Mo. Wm. B. Ittner, Architect. Fireproof. Cost $130,005=20.7c per cu. ft.



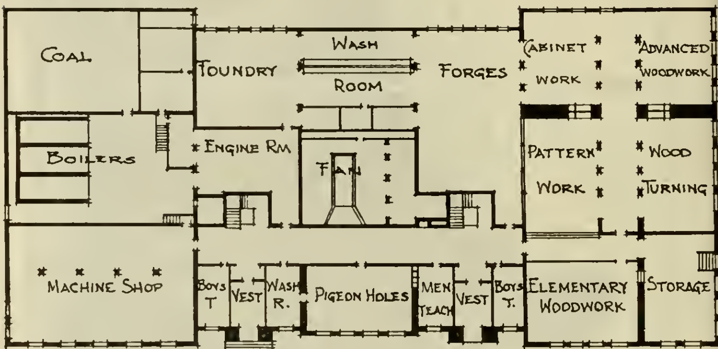
·SECOND FLOOR PLAN·
CLASS ROOM
RETIRING RM.
PLATFORM
RETIRING RM.
CLASS ROOM
COATS
COATS
LOBBY
LOBBY
COATS
COATS
ASSEMBLY HALL
CLASS ROOM
COATS
COATS
CLASS ROOM
·WASHINGTON SCHOOL AT·
·EAST ORANGE· ·N.J.·
·GUILBERT & BATELLE·ARCHTS·
CLASS ROOM
STORES
PRINCIPAL
COATS
KINDERGARTEN
COATS
TEACHERS
MEDICAL INSPEC.
CLASS ROOM
COATS
COATS
CORRIDOR
COATS
COATS
CLASS RM.
CLASS RM.
CLASS ROOM
CLASS ROOM
·FIRST FLOOR PLAN·
·SCALE 5 10 20 30 FEET·
EXIT
EXIT
STORES
GIRLS' TOILET
HEATING
COAL ROOM
BOILER ROOM
JANITOR
HEATING
BOYS' TOILET
CORRIDOR
GIRLS' PLAY ROOM
BOYS' PLAY ROOM
DOMESTIC SCIENCE
MANUAL TRAINING
·BASEMENT PLAN·



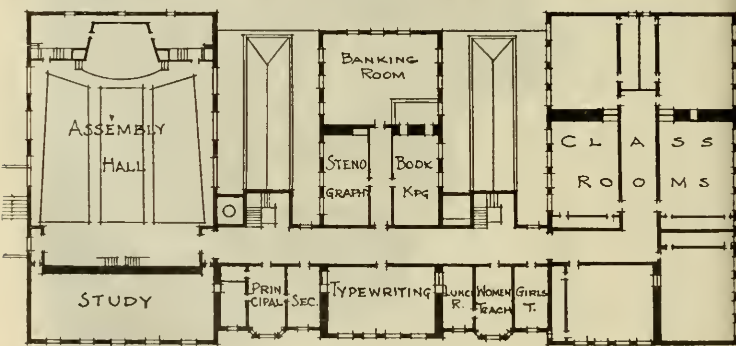
Washington School, East Orange, N. J. Guilbert & Battelle, Architects.



5 25 50 SCALE FOURTH FLOOR

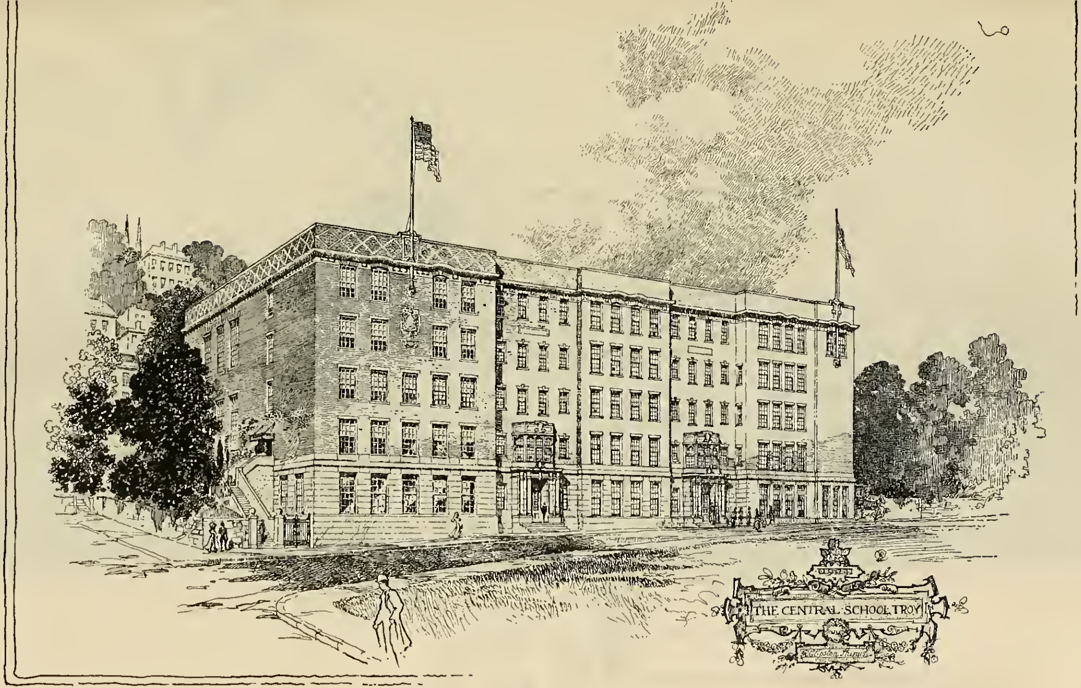


5 25 50 SCALE BASEMENT

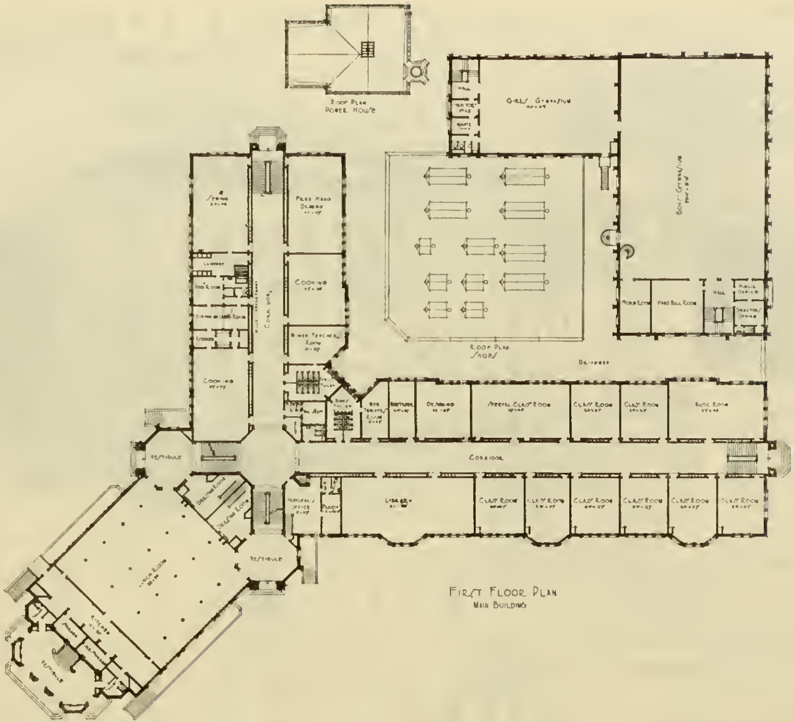


5 25 50 SCALE FIRST FLOOR

Central School. Troy, N. Y., R. Clipston Sturgis, Architect, Boston.

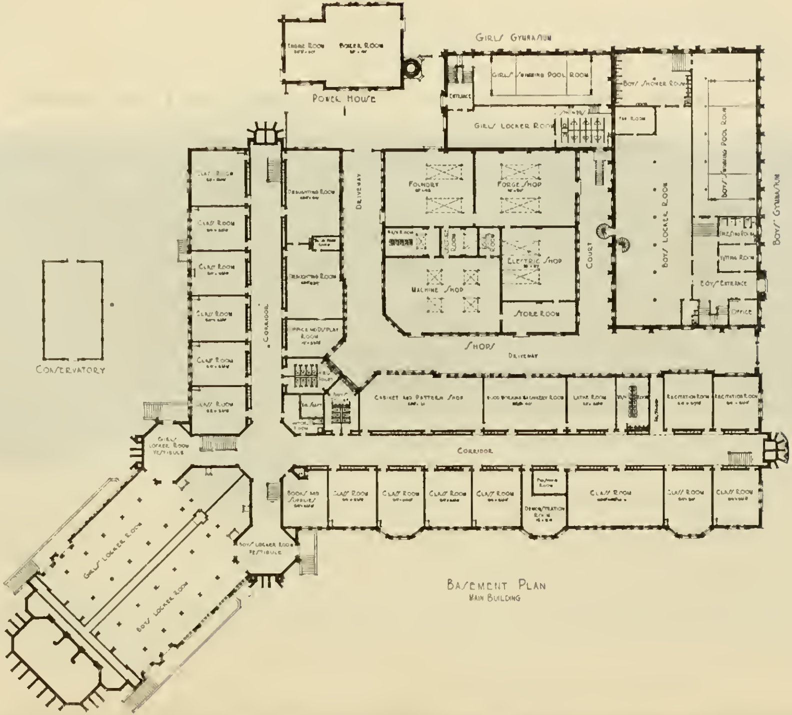


Central School, Troy N. Y. R. Clipston Sturgis, Architect, Boston. Cost $302,416= 21c per cu. ft.

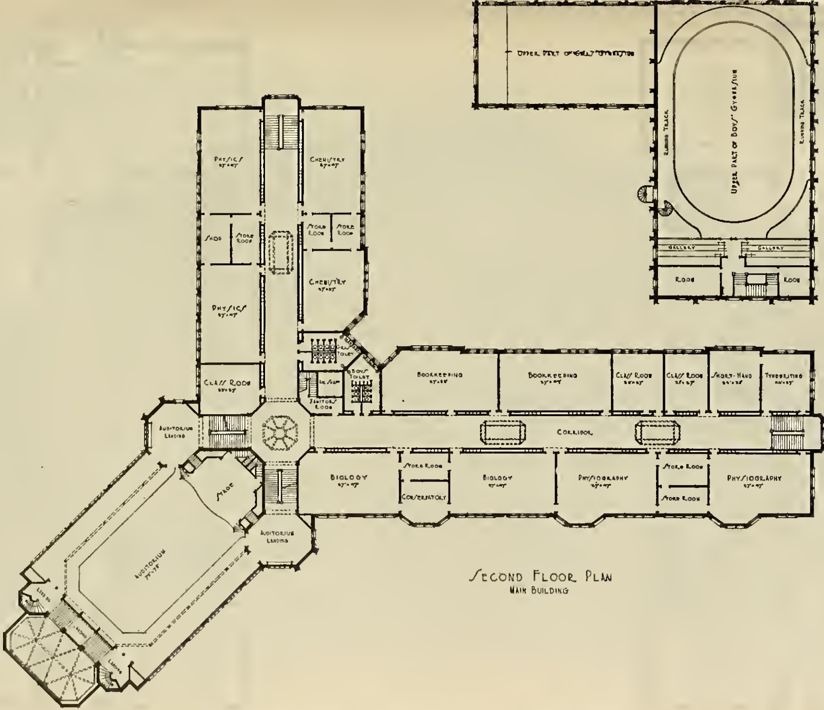


Lincoln Park High School, Tacoma, Wash. Heath & Gove, Architects, Tacoma.

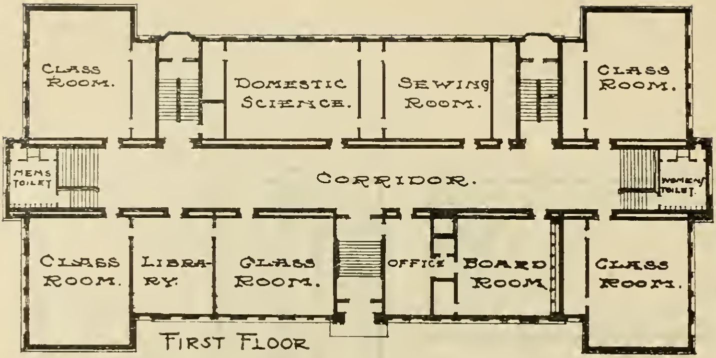
Lincoln Park High School, Tacoma, Wash. Heath & Gove, Architects.

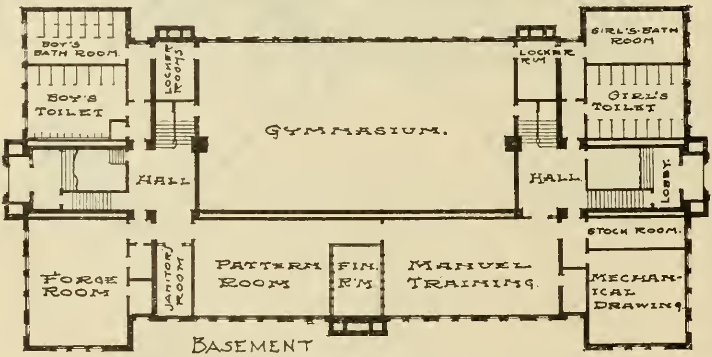


Lincoln Park High School, Tacoma, Wash.



Lincoln Park High School, Tacoma, Wash.

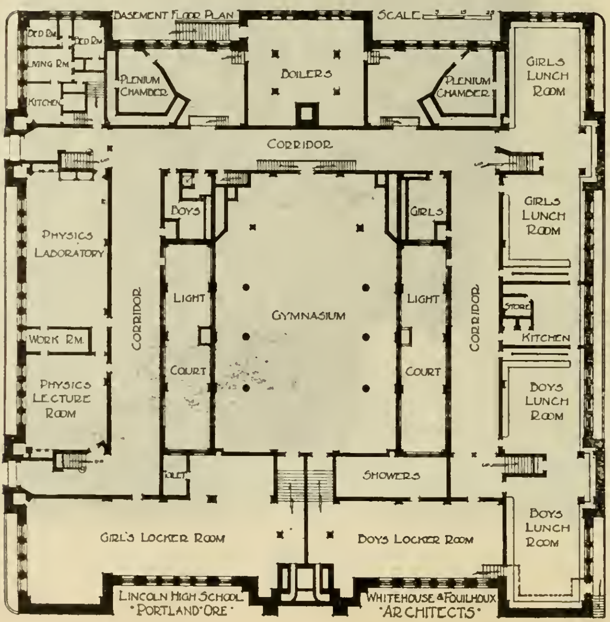




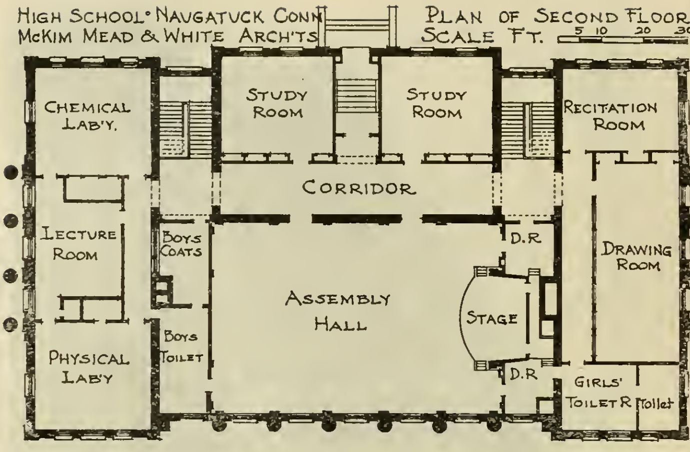
High School, Virginia, Minn., Tyree & Chapman, Architects.

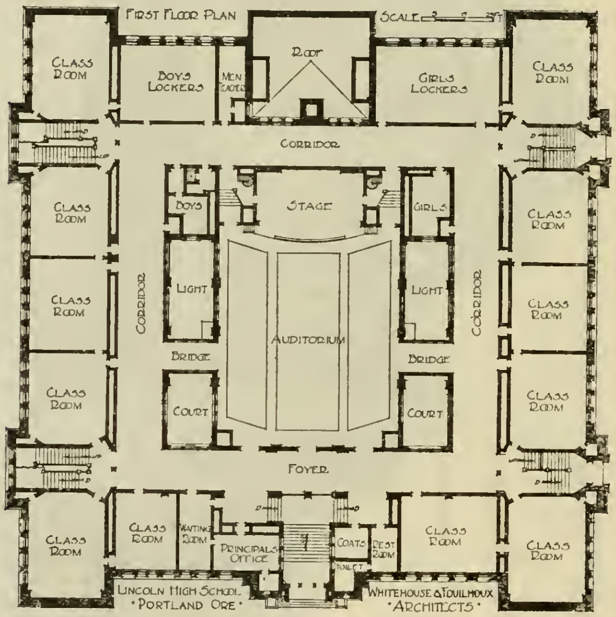
High School, Virginia, Minn. Tyree & Chapman, Architects, Minneapolis, Minn.


THIRD FLOOR PLAN
SCALE 5 15 25 FT.
DINING ROOM
COOKING LECTURE
STORE
APRONS
COOKING LABORATORY
ZOOLOGY LABORATORY
ZOOLOGY LECTURE
WORK ROOM
CORRIDOR
BOYS
PENMANSHIP
TYPEWRITERS
TYPEWRITERS
TYPEWRITERS
GIRLS
CHEMISTRY LABORATORY
PHYSIOGRAPHY LECTURE ROOM
LIGHT
STORE ROOM
COMMERCIAL DEP'T
LIGHT
STORE
DARK ROOM
SUPERVISOR ROOM
PHYSIOGRAPHY LABORATORY
CHEMISTRY LECTURE
COURT
INDUSTRIAL ART
SHORTHAND ROOM
COURT
CORRIDOR
CORRIDOR
CORRIDOR
MECHANICAL DRAWING
FREEHAND DRAWING
STORE
DESIGN ROOM
STORES
BOTANY LECTURE
BOTANY LABORATORY
LINCOLN HIGH SCHOOL PORTLAND ORE.
WHITEHOUSE & FOUILHOUX ARCHITECTS

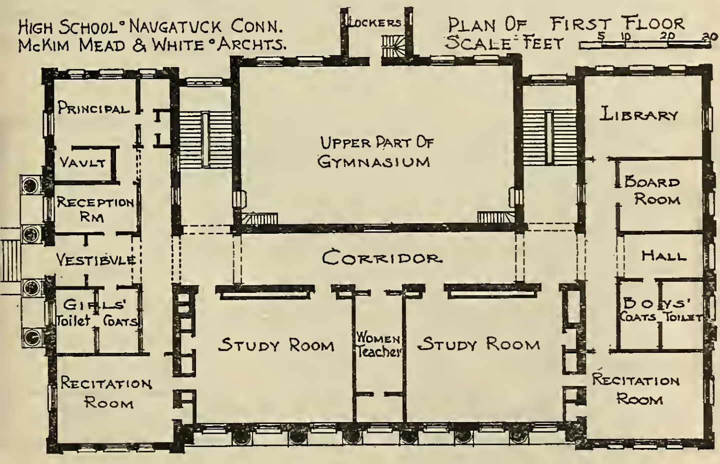

BASEMENT FLOOR PLAN
SCALE 5 15 25
BED RM.
BED RM.
LIVING RM.
KITCHEN
PLENIUM CHAMBER
BOILERS
PLENIUM CHAMBER
GIRLS LUNCH ROOM
CORRIDOR
BOYS
GIRLS
GIRLS LUNCH ROOM
PHYSICS LABORATORY
LIGHT
GYMNASIUM
LIGHT
STORE
KITCHEN
WORK RM.
CORRIDOR
CORRIDOR
COURT
COURT
PHYSICS LECTURE ROOM
BOYS LUNCH ROOM
TOILET
SHOWERS
GIRL'S LOCKER ROOM
BOYS LOCKER ROOM
BOYS LUNCH ROOM
LINCOLN HIGH SCHOOL · PORTLAND · ORE ·
WHITEHOUSE & FOUILHOUX · ARCHITECTS ·

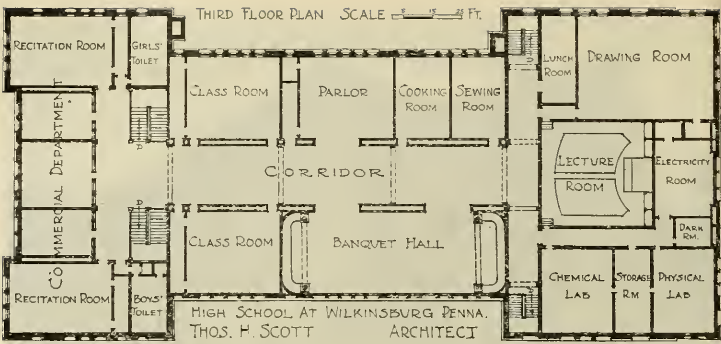
Lincoln High School, Portland, Ore. Whitehouse & Fouilhoux, Architects.

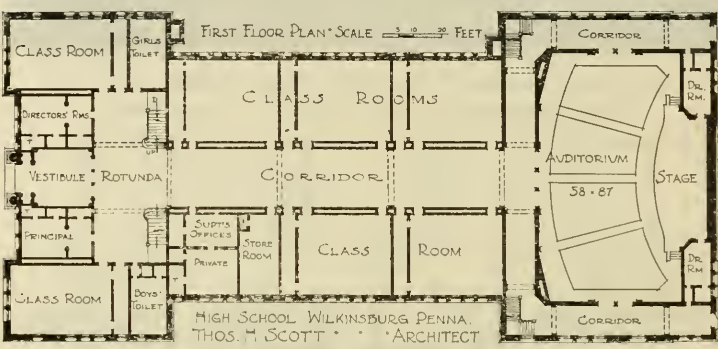

HIGH SCHOOL· NAUGATUCK CONN
McKIM MEAD & WHITE ARCH'TS
PLAN OF SECOND FLOOR
SCALE FT. 5 10 20 30
CHEMICAL LAB'Y.
STUDY ROOM
STUDY ROOM
RECITATION ROOM
CORRIDOR
LECTURE ROOM
BOYS COATS
D.R
DRAWING ROOM
ASSEMBLY HALL
STAGE
BOYS TOILET
PHYSICAL LAB'Y
D.R
GIRLS' TOILET R
Toilet

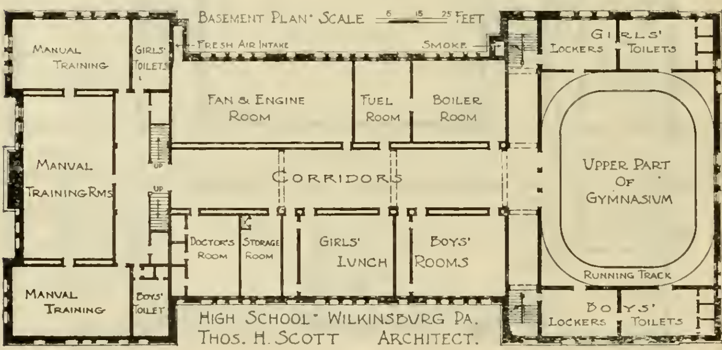

FIRST FLOOR PLAN
SCALE
CLASS ROOM
BOYS LOCKERS
MEN TEACHERS
ROOF
GIRLS LOCKERS
CLASS ROOM
CORRIDOR
CLASS ROOM
BOYS
STAGE
GIRLS
CLASS ROOM
CLASS ROOM
CORRIDOR
LIGHT
LIGHT
CORRIDOR
CLASS ROOM
AUDITORIUM
BRIDGE
BRIDGE
CLASS ROOM
COURT
COURT
CLASS ROOM
FOYER
CLASS ROOM
CLASS ROOM
WAITING ROOM
PRINCIPALS OFFICE
COATS
REST ROOM
TOILET
CLASS ROOM
CLASS ROOM
LINCOLN HIGH SCHOOL
·PORTLAND ORE·
WHITEHOUSE & FOUILHOUX
·ARCHITECTS·

High School, Naugatuck, Conn., McKim, Mead & White, Architects.
From Photogravure by A. W. Elson Co., Boston, Mass.

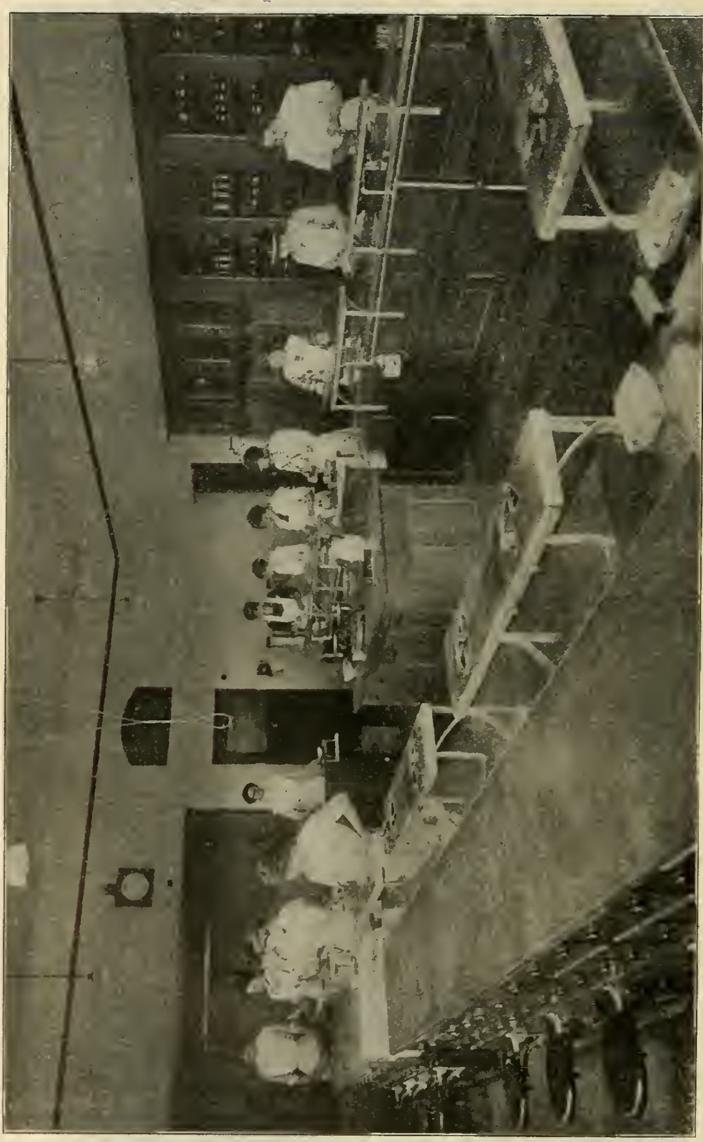



THIRD FLOOR PLAN SCALE 5 15 25 FT.
RECITATION ROOM
GIRLS' TOILET
COMMERCIAL DEPARTMENT
RECITATION ROOM
BOYS' TOILET
CLASS ROOM
PARLOR
COOKING ROOM
SEWING ROOM
CORRIDOR
CLASS ROOM
BANQUET HALL
LUNCH ROOM
DRAWING ROOM
LECTURE ROOM
ELECTRICITY ROOM
DARK RM.
CHEMICAL LAB
STORAGE RM
PHYSICAL LAB
HIGH SCHOOL AT WILKINSBURG PENNA.
THOS. H. SCOTT ARCHITECT

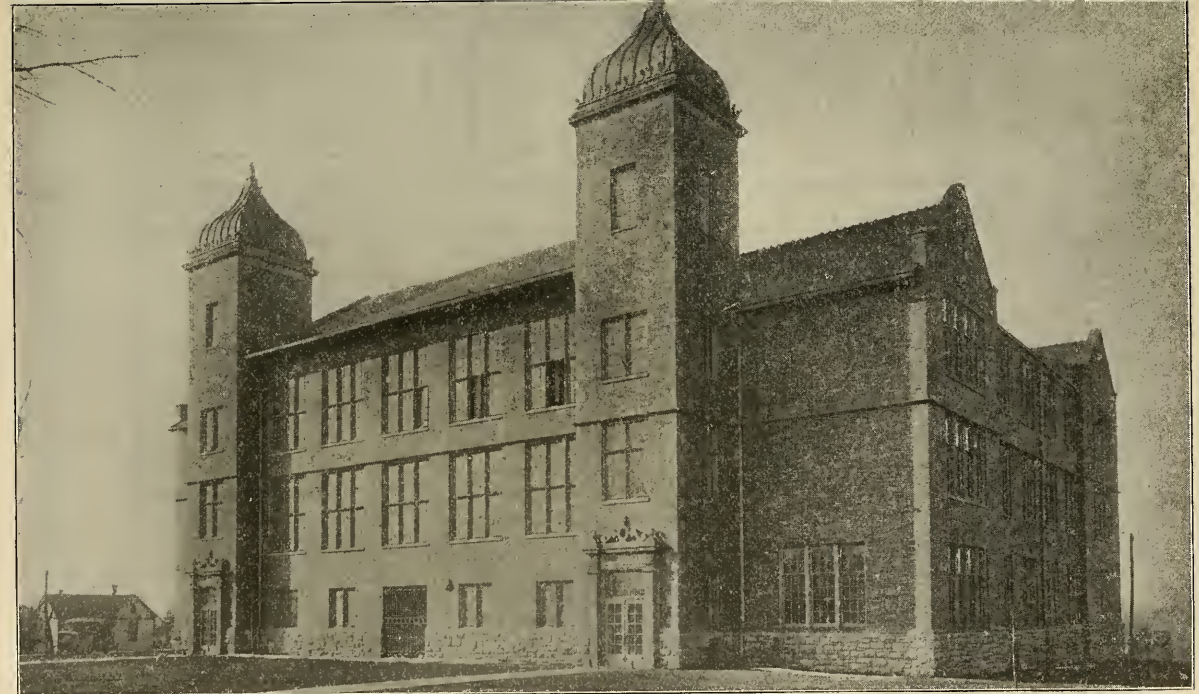

FIRST FLOOR PLAN SCALE 5 10 20 FEET
CLASS ROOM
GIRLS TOILET
DIRECTORS' RMS
VESTIBULE
ROTUNDA
PRINCIPAL
CLASS ROOM
BOYS' TOILET
CLASS ROOMS
CORRIDOR
SUPT'S OFFICES
PRIVATE
STORE ROOM
CLASS ROOM
CORRIDOR
DR. RM.
AUDITORIUM
58 · 87
STAGE
DR RM
CORRIDOR
HIGH SCHOOL WILKINSBURG PENNA.
THOS. H SCOTT ARCHITECT


BASEMENT PLAN SCALE 5 15 25 FEET
FRESH AIR INTAKE
SMOKE
MANUAL TRAINING
GIRLS' TOILETS
MANUAL TRAINING RMS
MANUAL TRAINING
BOYS' TOILET
FAN & ENGINE ROOM
FUEL ROOM
BOILER ROOM
CORRIDORS
DOCTOR'S ROOM
STORAGE ROOM
GIRLS' LUNCH
BOYS' ROOMS
GIRLS' LOCKERS TOILETS
UPPER PART OF GYMNASIUM
RUNNING TRACK
BOYS' LOCKERS TOILETS
HIGH SCHOOL WILKINSBURG PA.
THOS. H. SCOTT ARCHITECT.

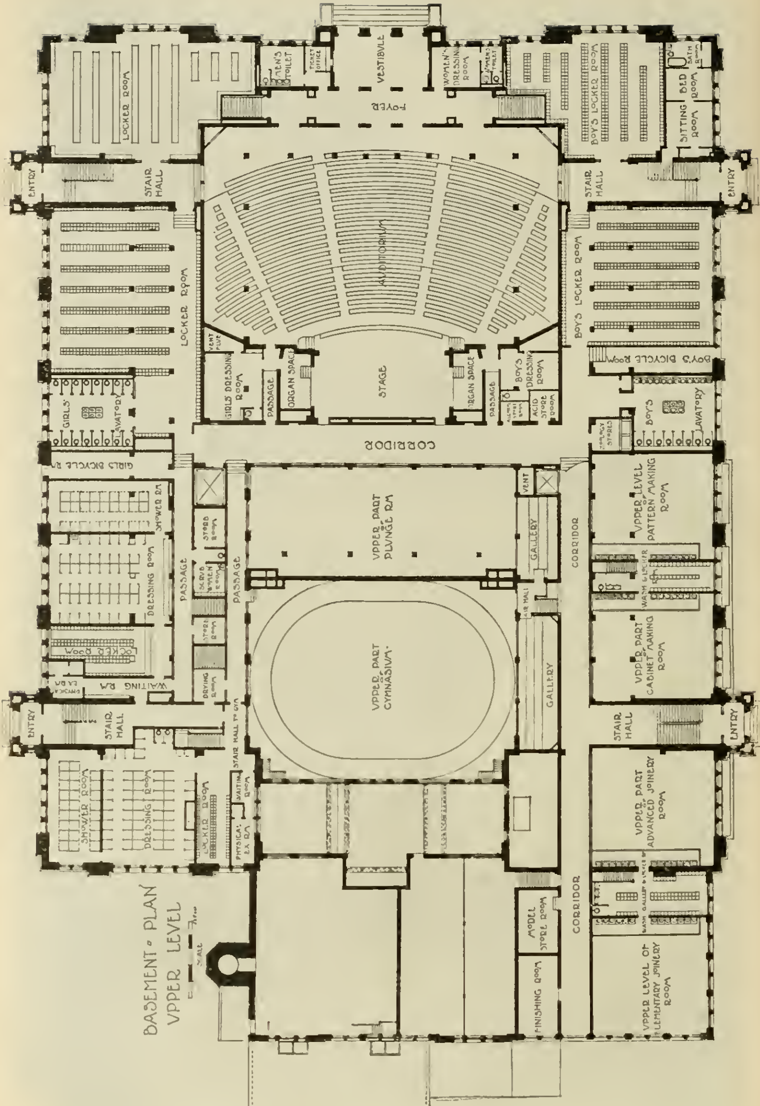
High School at Wilkinsburg, Pa. Thos. H. Scott, Architect, Pittsburg, Pa.
Fireproof. Cost $346,000—22.5c per cu. ft.



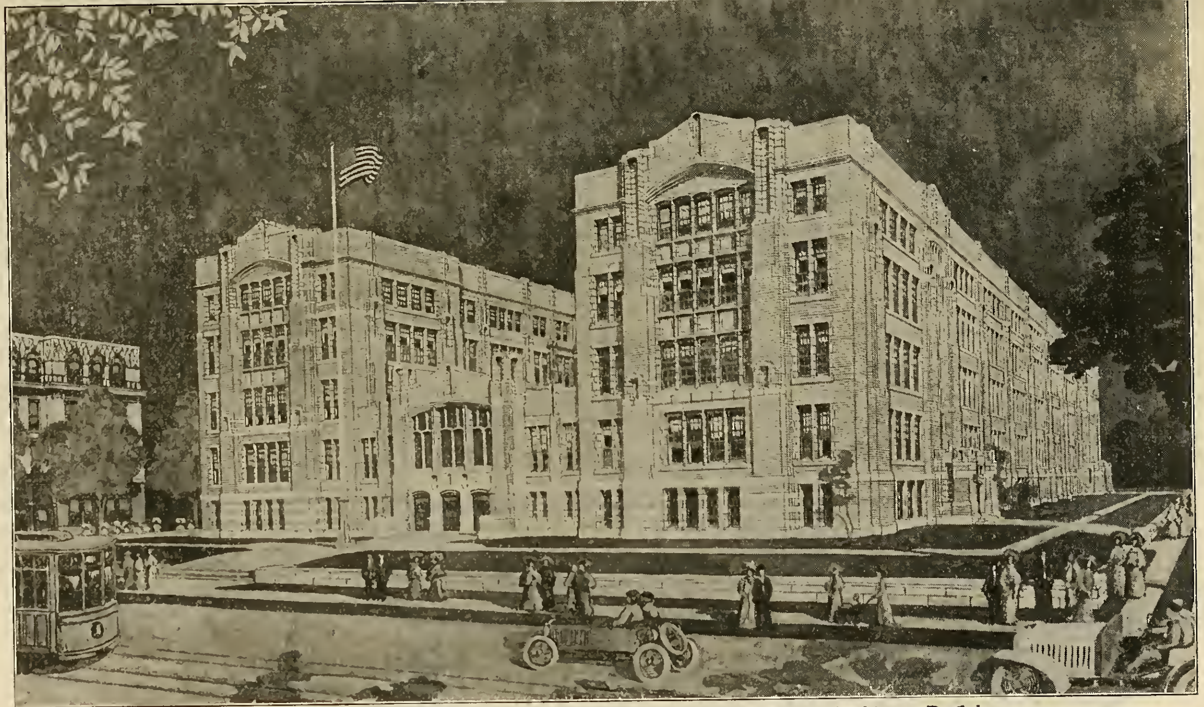
Domestic Science Room, Franklin High School, Seattle, Wash. See Plans and Exterior on Pages 591—4.



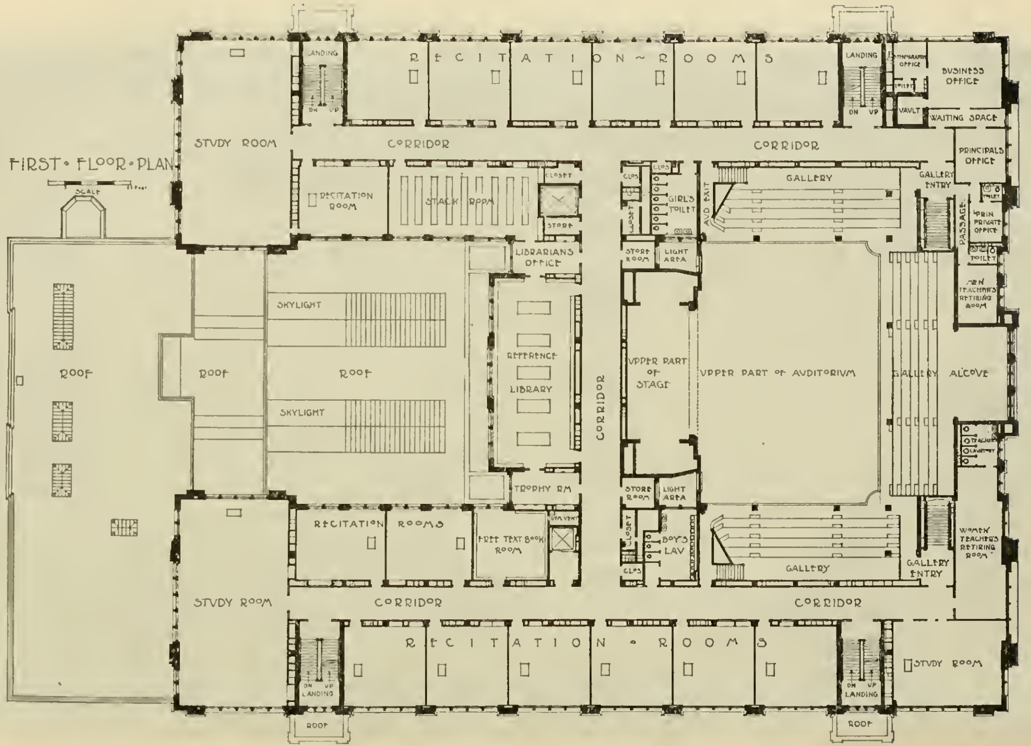
High School, Columbia, Mo. Wm. B. Ittner, Architect, St. Louis.



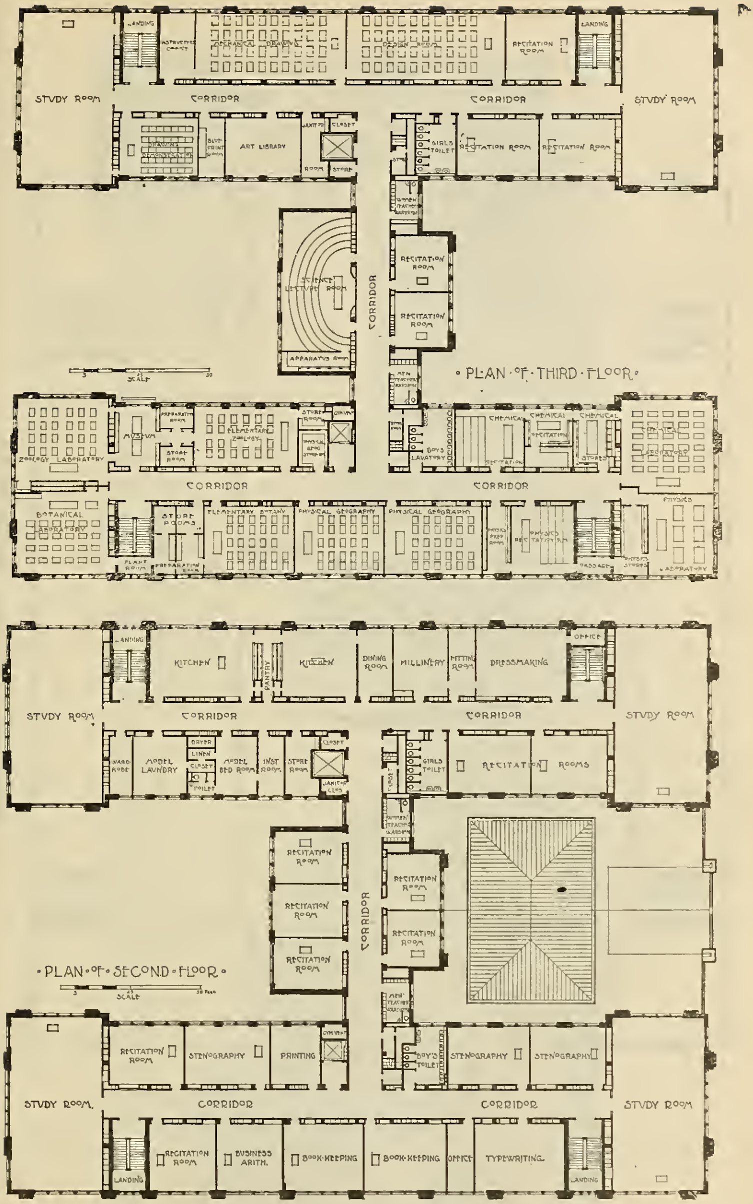
Hutchinson High School, Buffalo, N. Y.



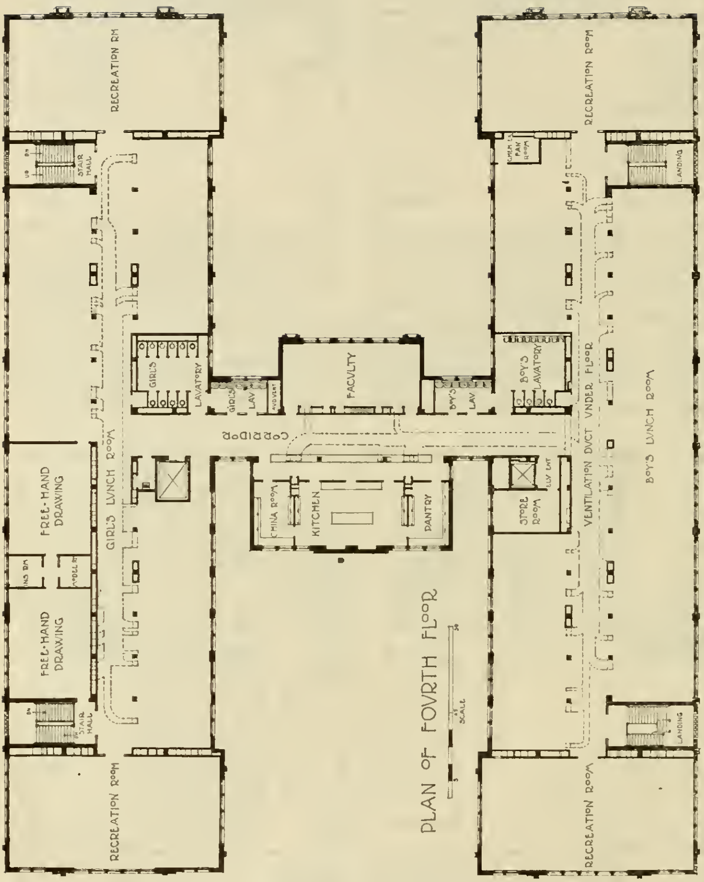
Hutchinson High School, Buffalo, N. Y. H. Osgood Holland, Architect, Buffalo.



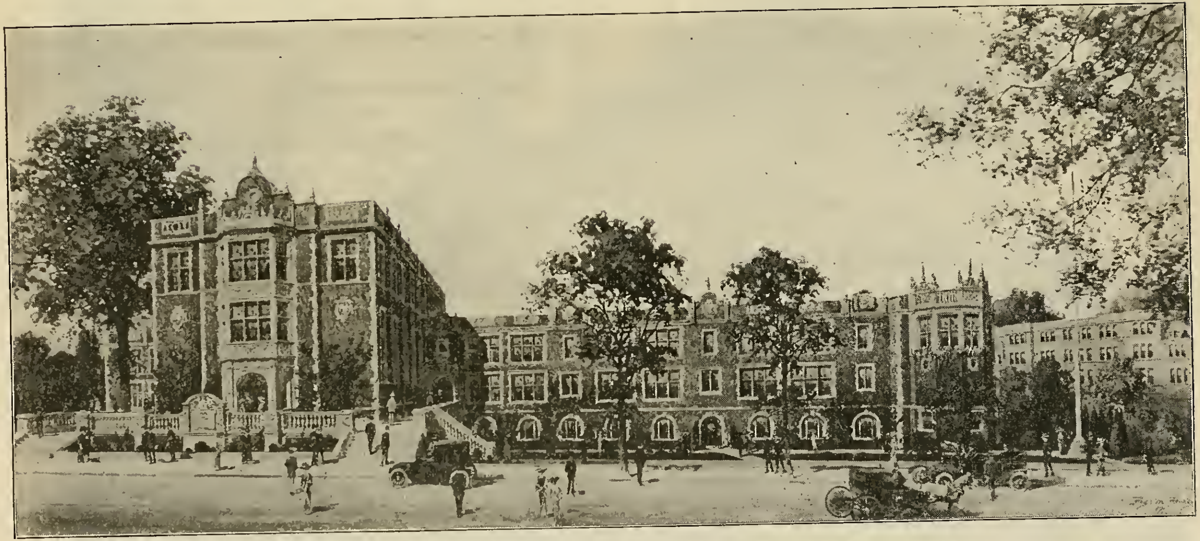
Hutchinson High School, Buffalo, N. Y. H. Osgood Holland, Architect, Buffalo.



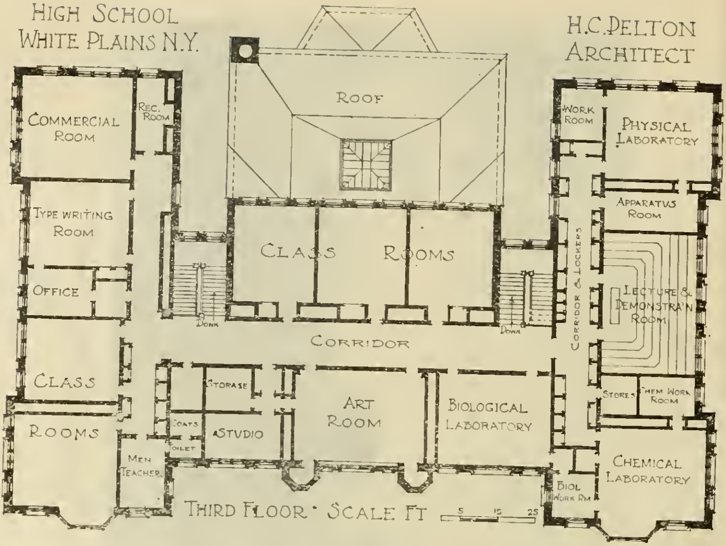
Hutchinson High School, Buffalo, N. Y.

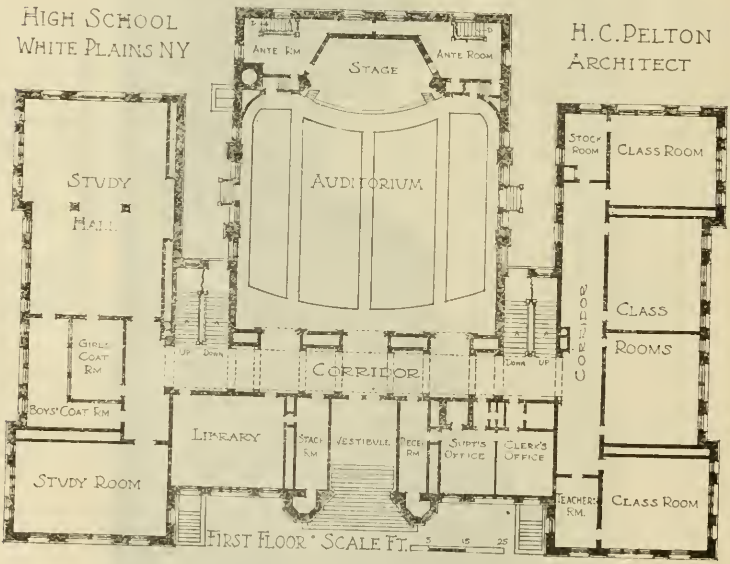


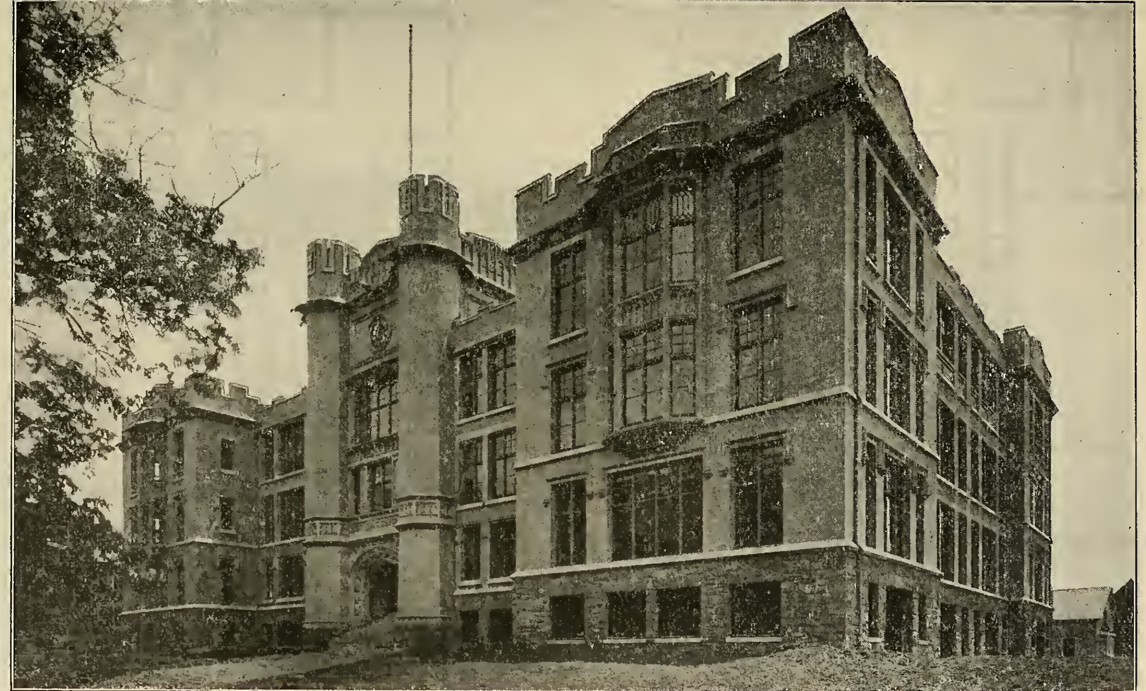
Hutchinson High School, Buffalo, N. Y.



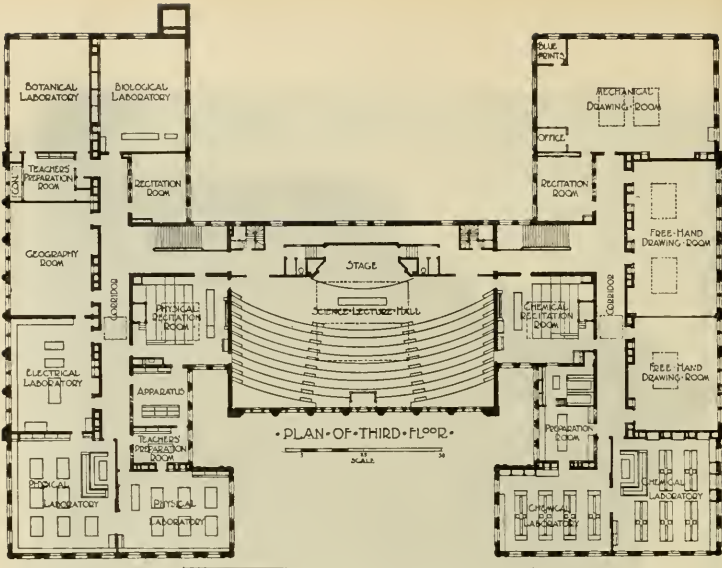
Normal School Building, Newark, N. J. E. F. Guilbert, Architect, Newark.

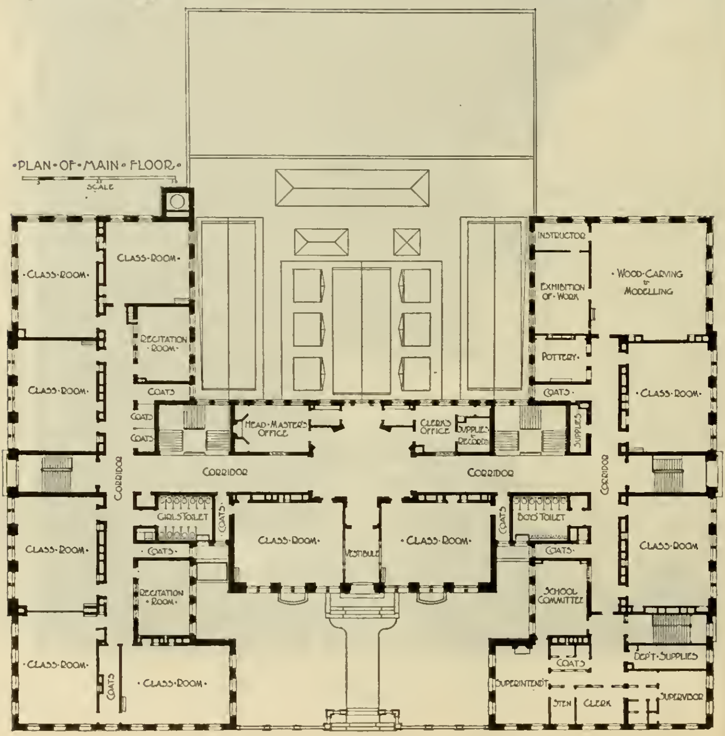

HIGH SCHOOL
WHITE PLAINS N.Y.
H.C.PELTON
ARCHITECT
ROOF
COMMERCIAL ROOM
REC. ROOM
TYPE WRITING ROOM
OFFICE
CLASS ROOMS
CLASS ROOMS
DOWN
DOWN
CORRIDOR
STORAGE
COATS
STUDIO
TOILET
MEN TEACHER
ART ROOM
BIOLOGICAL LABORATORY
WORK ROOM
PHYSICAL LABORATORY
APPARATUS ROOM
CORRIDOR & LOCKERS
LECTURE & DEMONSTRA'N ROOM
STORES
CHEM WORK ROOM
CHEMICAL LABORATORY
BIOL WORK RM
THIRD FLOOR · SCALE FT
5
15
25


HIGH SCHOOL
WHITE PLAINS NY
H.C.PELTON
ARCHITECT
ANTE RM
STAGE
ANTE ROOM
AUDITORIUM
STUDY HALL
GIRLS' COAT RM
BOYS' COAT RM
UP
DOWN
CORRIDOR
DOWN
UP
STOCK ROOM
CLASS ROOM
CORRIDOR
CLASS ROOMS
LIBRARY
STACK RM
VESTIBULE
RECEP RM
SUPT'S OFFICE
CLERK'S OFFICE
STUDY ROOM
TEACHERS' RM.
CLASS ROOM
FIRST FLOOR · SCALE FT.
5
15
25



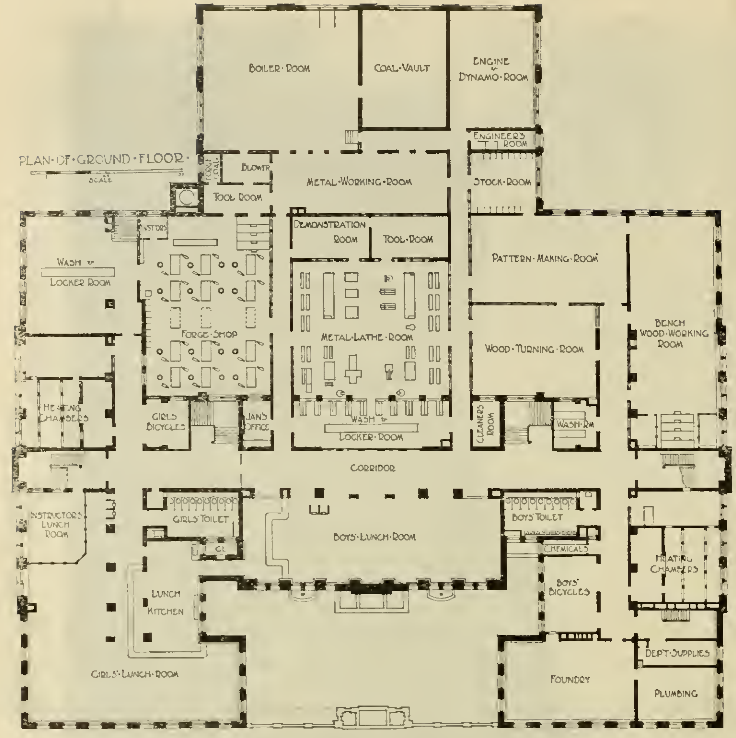
High School, White Plains, N. Y. Cost $205,000=15.6c. per cu. ft. H. C. Pelton, Architect, New York.



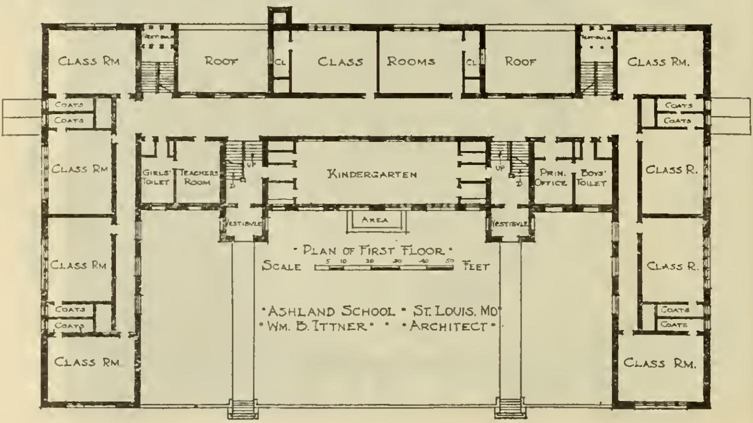


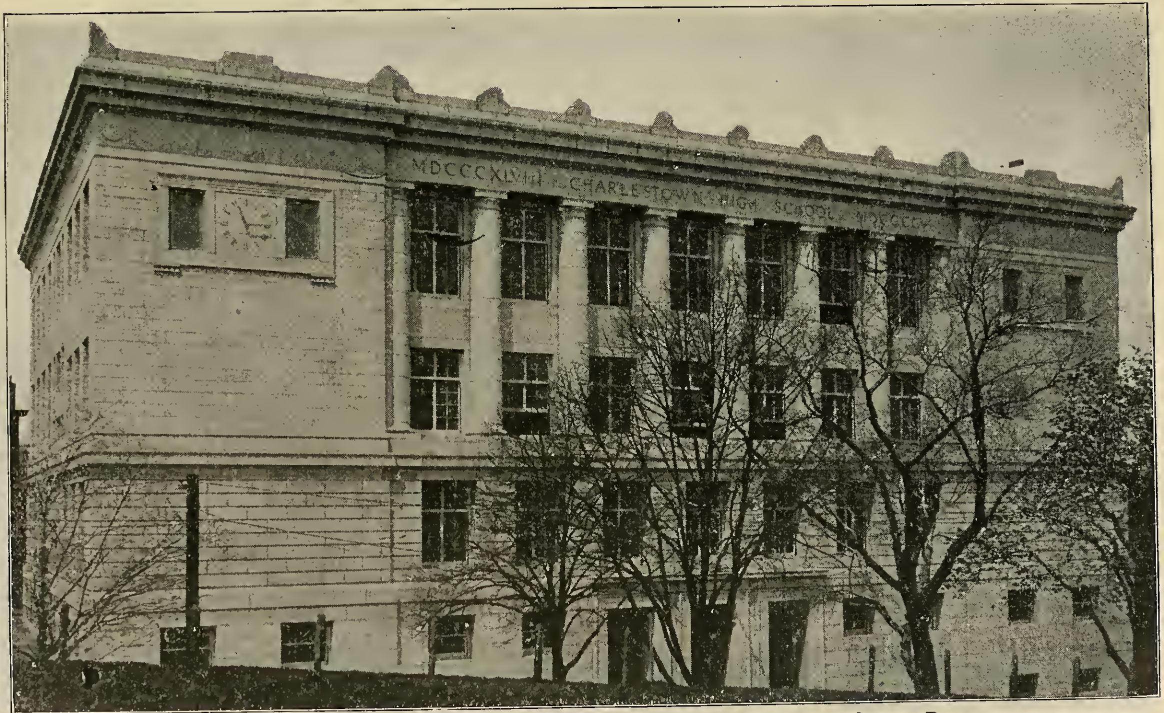
Newton Technical High School, Newton, Mass.

Newton Technical High School, Newton, Mass. Fireproof. Cost $348,248=18c. per cu. ft.
Geo. F. Newton, Architect, Boston, Mass.



Newton Technical High School, Newton, Mass.

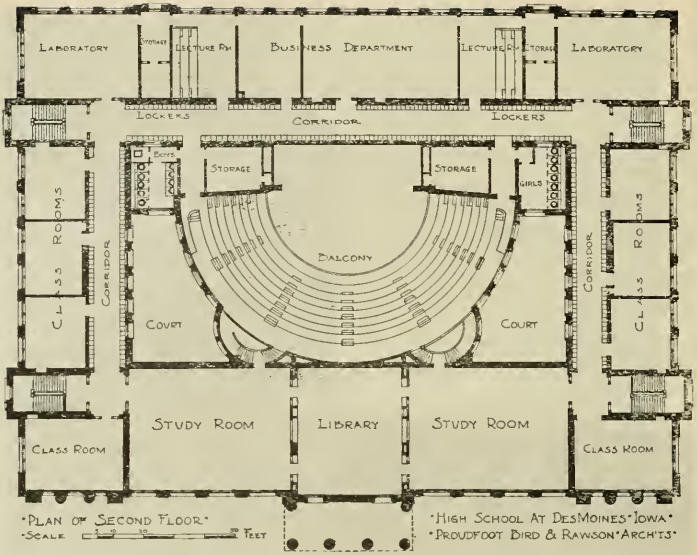




Charlestown High School, Charlestown, Mass. Stickney and Austin, Architects, Boston.

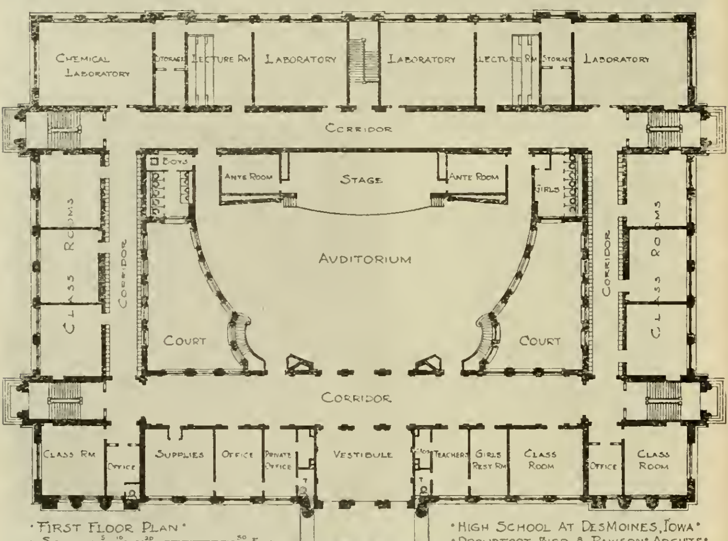
Assembly Hall, High School at Charlestown, Mass. Stickney and Austin, Architects, Boston.

Distant View of High School at Charlestown, Mass. Bunker Hill Monument in the foreground.



·Plan of Second Floor·
·Scale 5 10 20 50 Feet

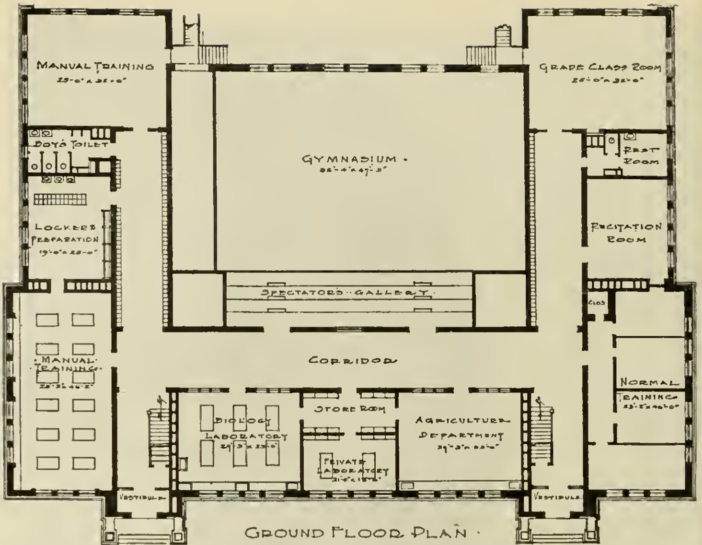
·High School at DesMoines·Iowa·
·Proudfoot Bird & Rawson·Arch'ts·



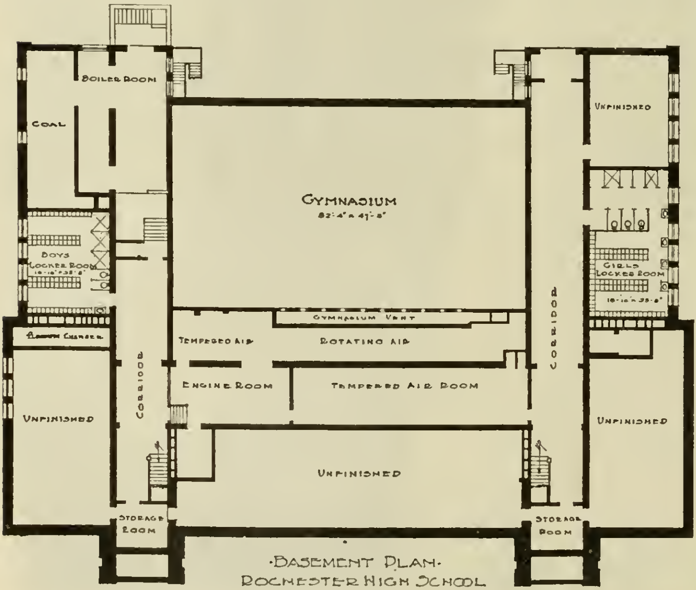
·First Floor Plan·
·Scale 5 10 20 50 Feet

·High School at DesMoines, Iowa·
·Proudfoot, Bird & Rawson·Arch'ts·

High School, Des Moines, Iowa. Proudfoot, Bird and Rawson, Architects.

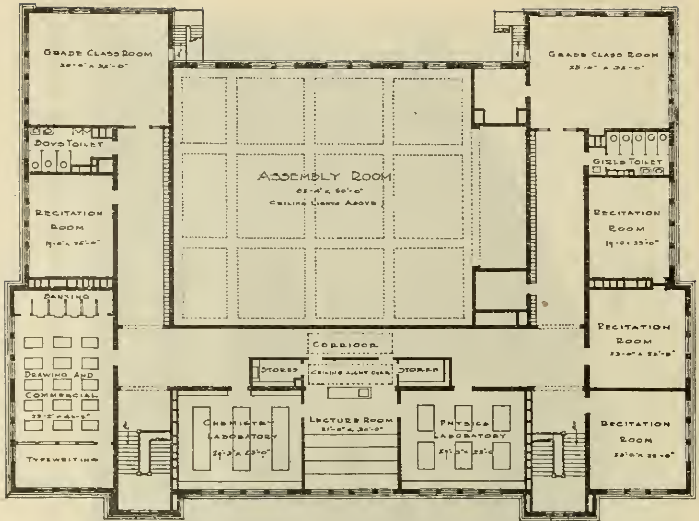


·Ground Floor Plan·
·Rochester High School·

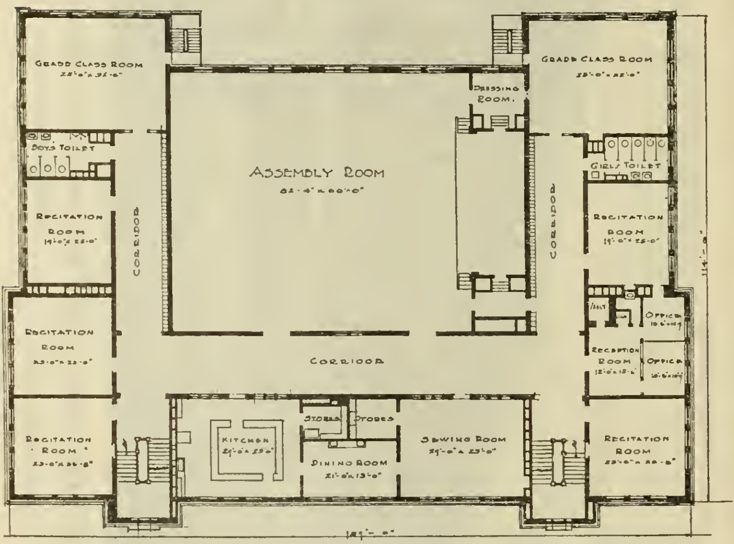


·Basement Plan·
Rochester High School

High School at Rochester, Minn. Stairs and corridors fireproof. Cost 17c. cu. ft. Patton and Miller, Architects, Chicago.

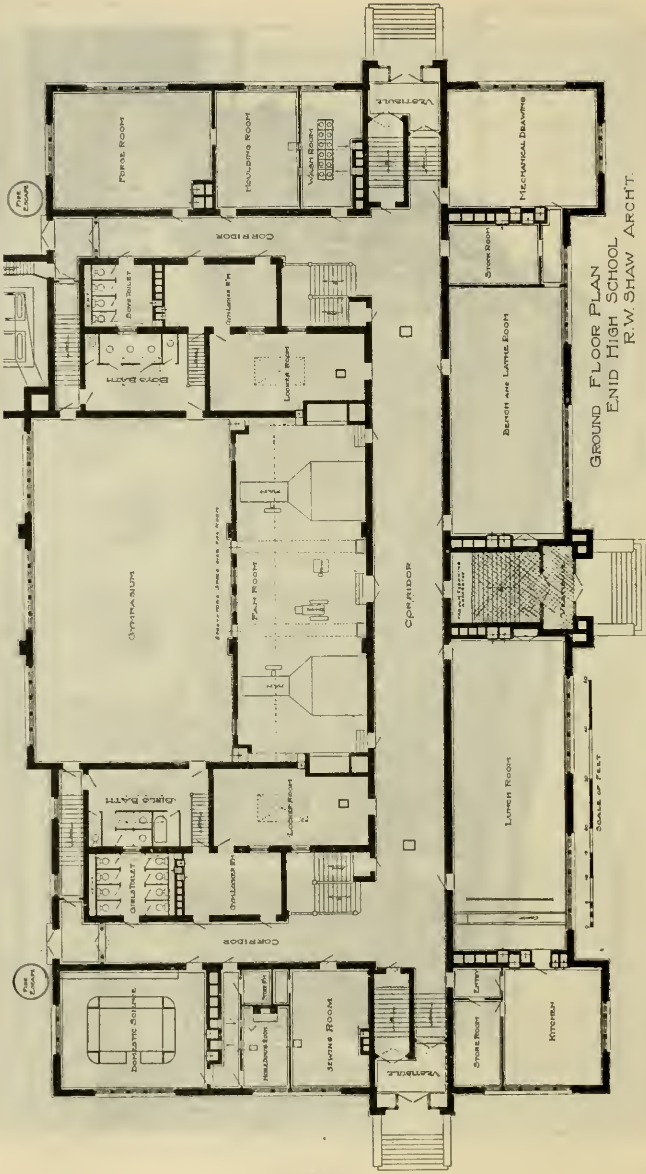


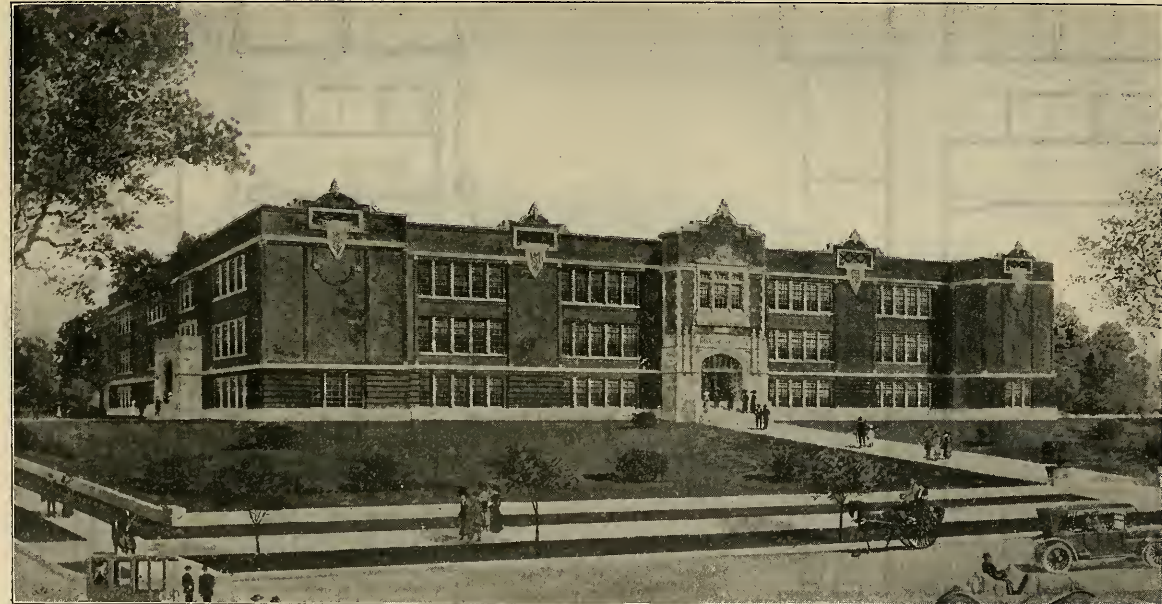
· SECOND · FLOOR · PLAN ·
ROCHESTER HIGH SCHOOL



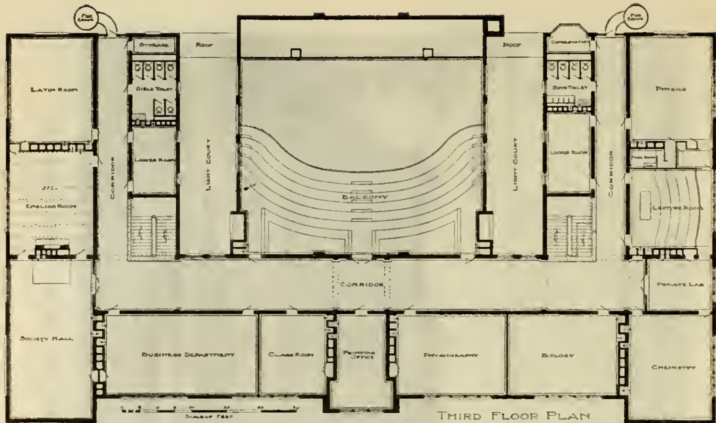
FIRST FLOOR PLAN
ROCHESTER HIGH SCHOOL

Woodward High School at Cincinnati, O. Gustav Drach, Architect.

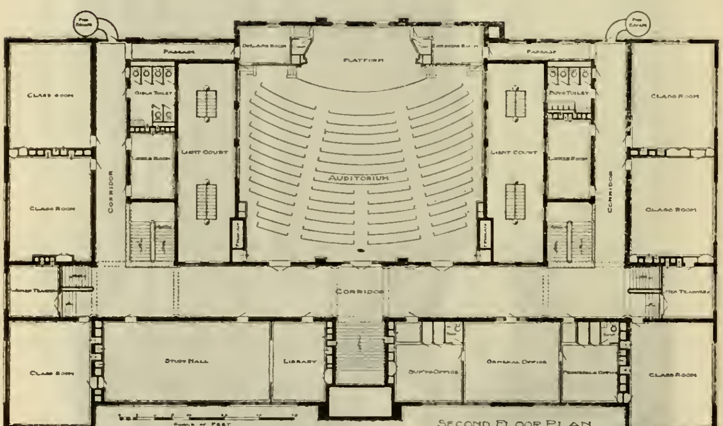

GROUND FLOOR PLAN
ENID HIGH SCHOOL
R.W. SHAW ARCH'T.
FORGE ROOM
MOULDING ROOM
WASH ROOM
VESTIBULE
MECHANICAL DRAWING
FIRE ESCAPE
CORRIDOR
STOCK ROOM
BOYS TOILET
GYM LOCKER R'M
BOYS BATH
LOCKER ROOM
BENCH AND LATHE ROOM
GYMNASIUM
FAN ROOM
CORRIDOR
VESTIBULE
LUNCH ROOM
SCALE OF FEET
GIRLS BATH
LOCKER ROOM
GIRLS TOILET
GYM LOCKER R'M
CORRIDOR
FIRE ESCAPE
DOMESTIC SCIENCE
SEWING ROOM
VESTIBULE
STORE ROOM
KITCHEN



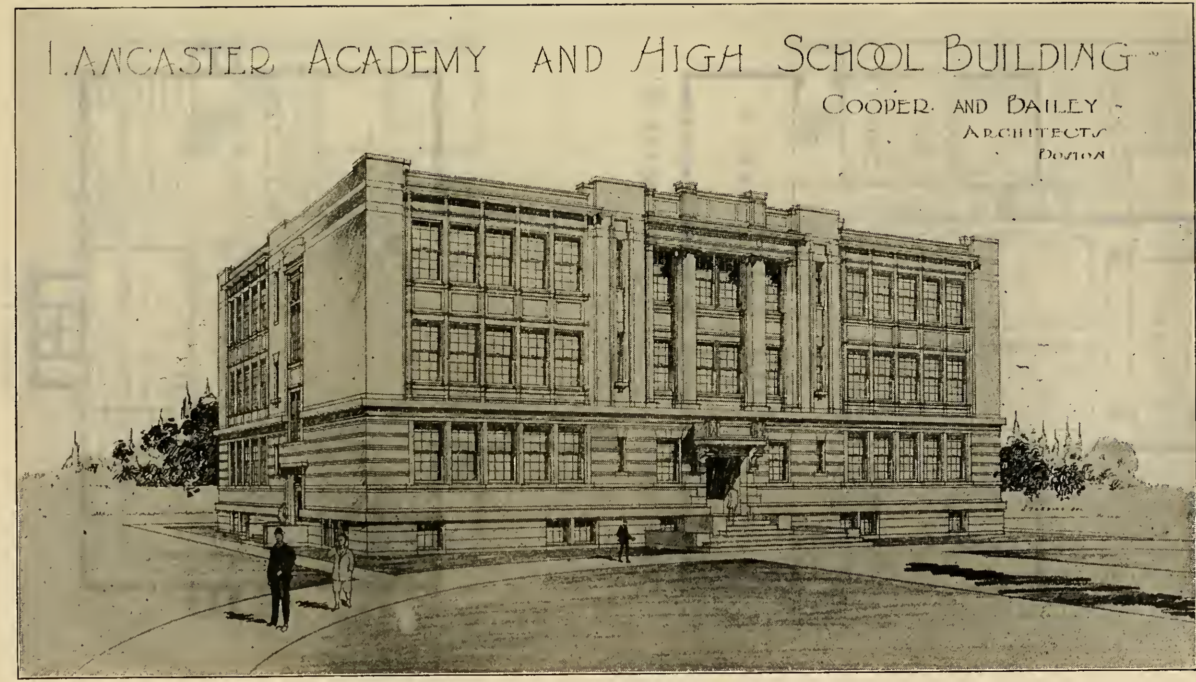
High School at Enid, Oklahoma. R. W. Shaw, Architect. Cost 13c. per cu. ft. (Not fireproof.)

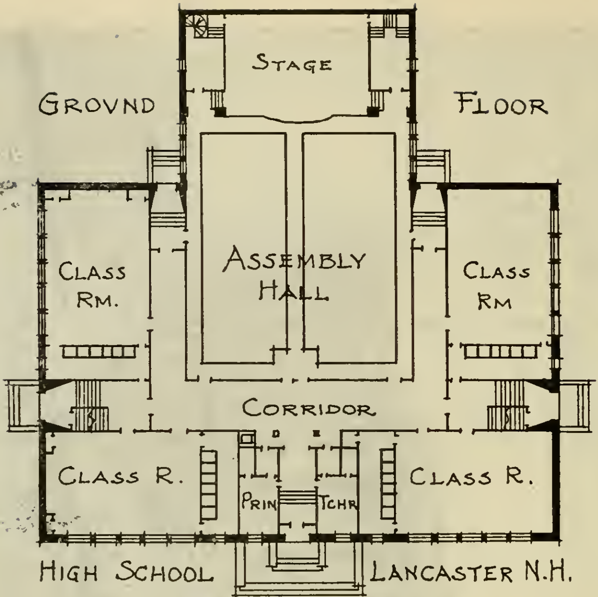


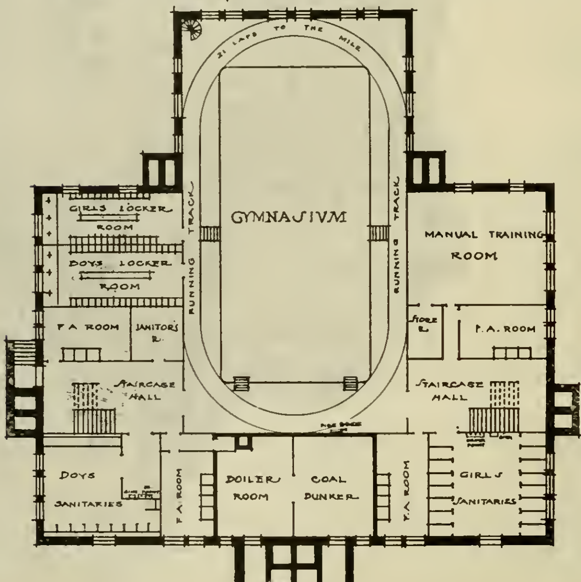
THIRD FLOOR PLAN
ENID HIGH SCHOOL
R W SHAW. ARCH'T.



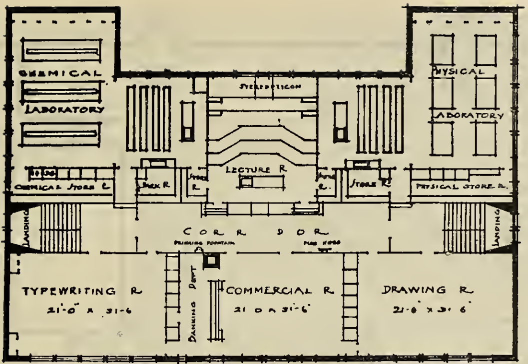
SECOND FLOOR PLAN
ENID HIGH SCHOOL
R. W. SHAW ARCH'T


LANCASTER ACADEMY AND HIGH SCHOOL BUILDING
COOPER AND BAILEY
ARCHITECTS
BOSTON

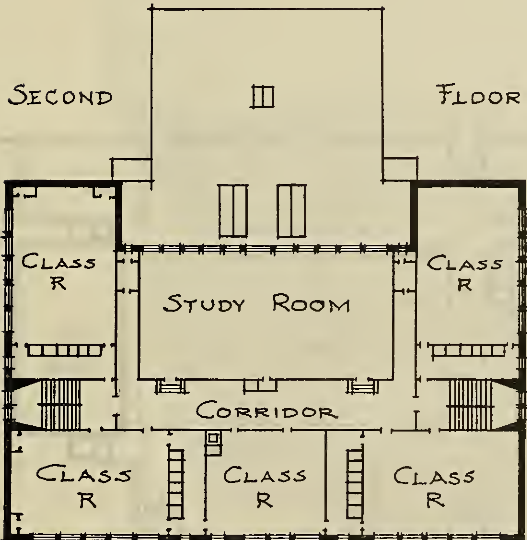




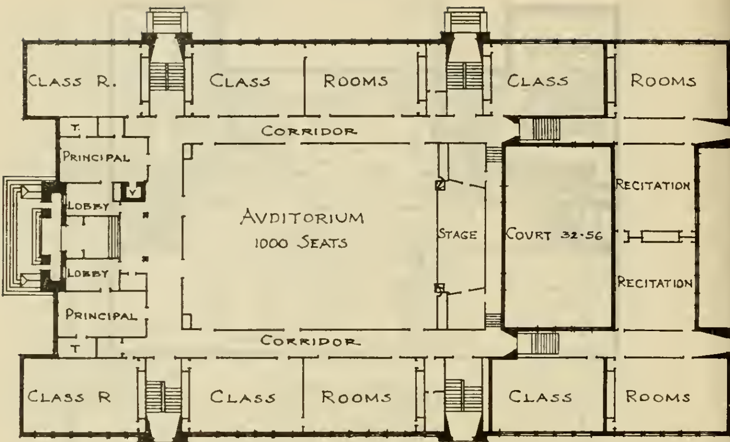
Basement Plan.



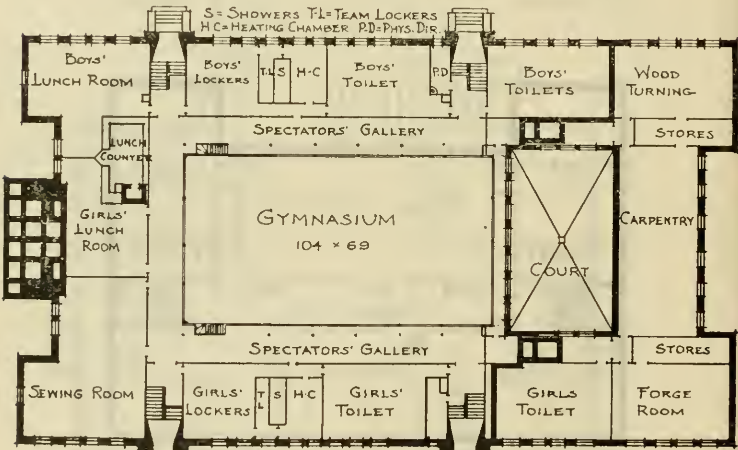
Third Floor Plan.



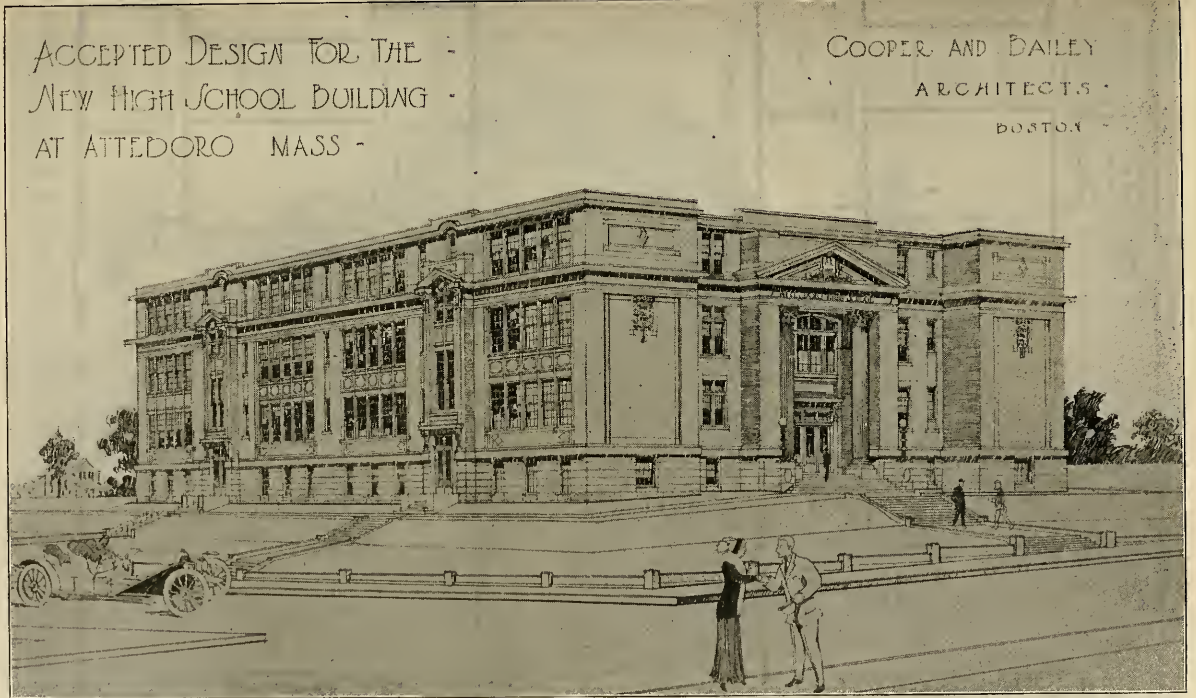
HIGH SCHOOL ° ° LANCASTER N.H.
COOPER & BAILEY ° ARCHITECTS.



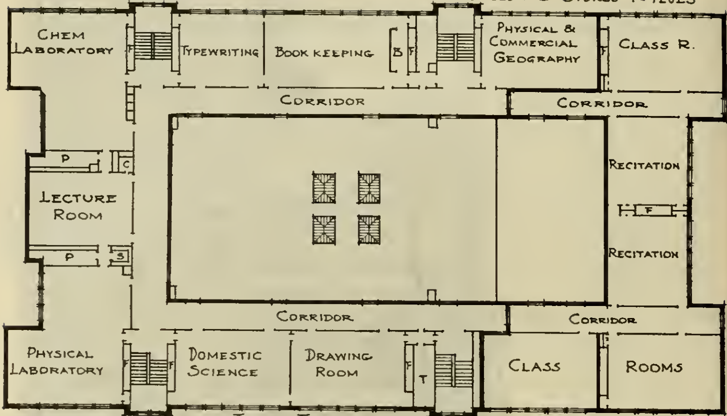
GROUND FLOOR
HIGH SCHOOL ATTLEBORO MASS. COOPER & BAILEY ARCHITECTS



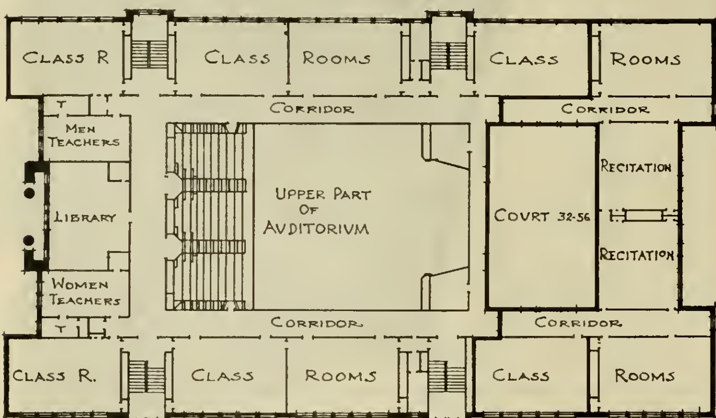
BASEMENT
HIGH SCHOOL ATTLEBORO MASS. COOPER & BAILEY ARCHITECTS


ACCEPTED DESIGN FOR THE -
NEW HIGH SCHOOL BUILDING -
AT ATTLEBORO MASS -
COOPER AND BAILEY
ARCHITECTS -
BOSTON -

P= INSTRUCTOR'S PREP. RM. B= BANK T= TOILET C= CLOS. S= STORES F= FLUES

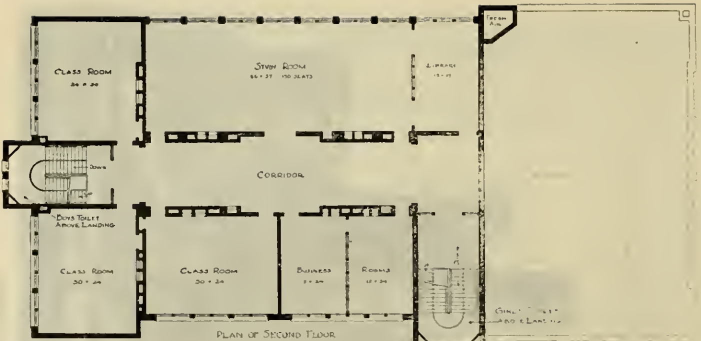


THIRD FLOOR
HIGH SCHOOL ATTLEBORO MASS. COOPER & BAILEY ARCHITECTS

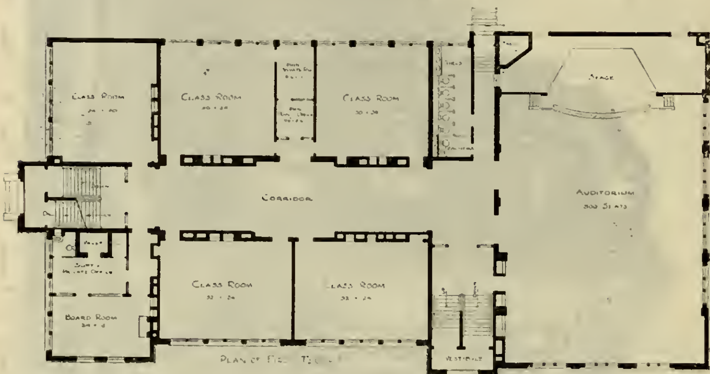


SECOND FLOOR
HIGH SCHOOL ATTLEBORO MASS. COOPER & BAILEY ARCHITECTS

McKinley High School, St. Louis, Mo. Wm. B. Ittner, Architect.

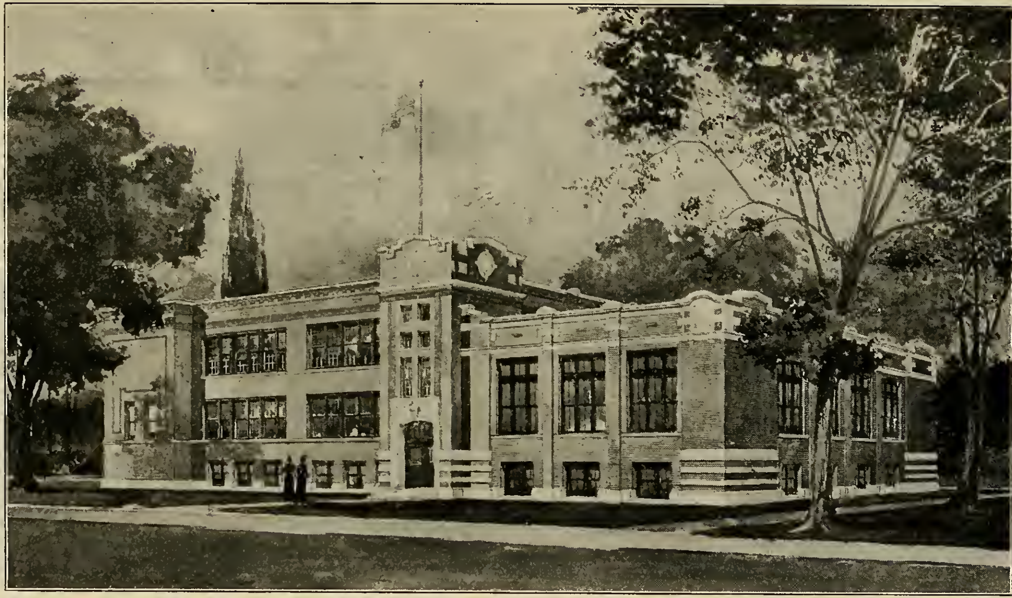


HIGH SCHOOL LONDON O WILBUR T MILLS ARCHITECT.

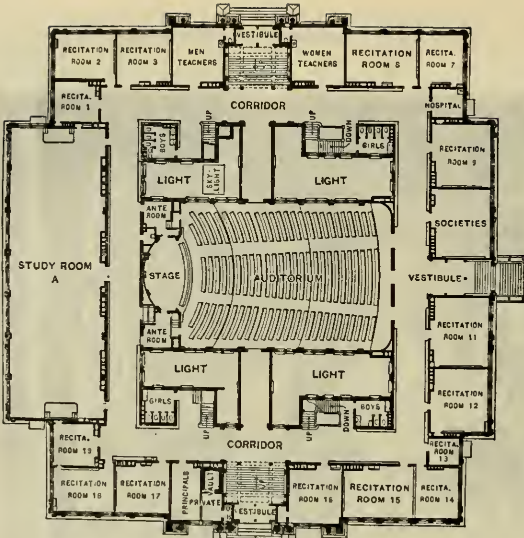


HIGH SCOOL LONDON OHIO WILBUR T MILLS ARCHITECT

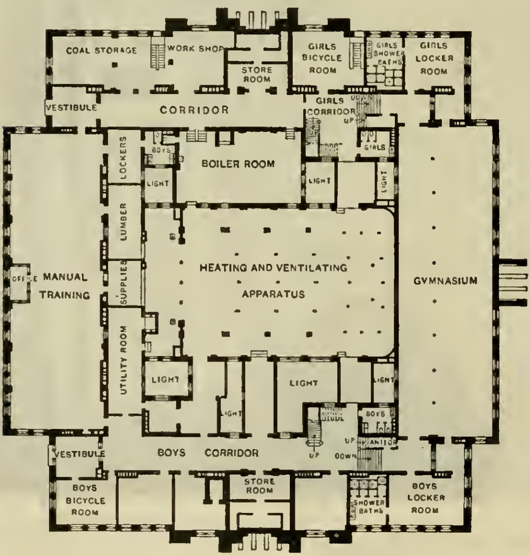
HIGH SCOOL LONDON OHIO WILBUR T MILLS ARCHITECT



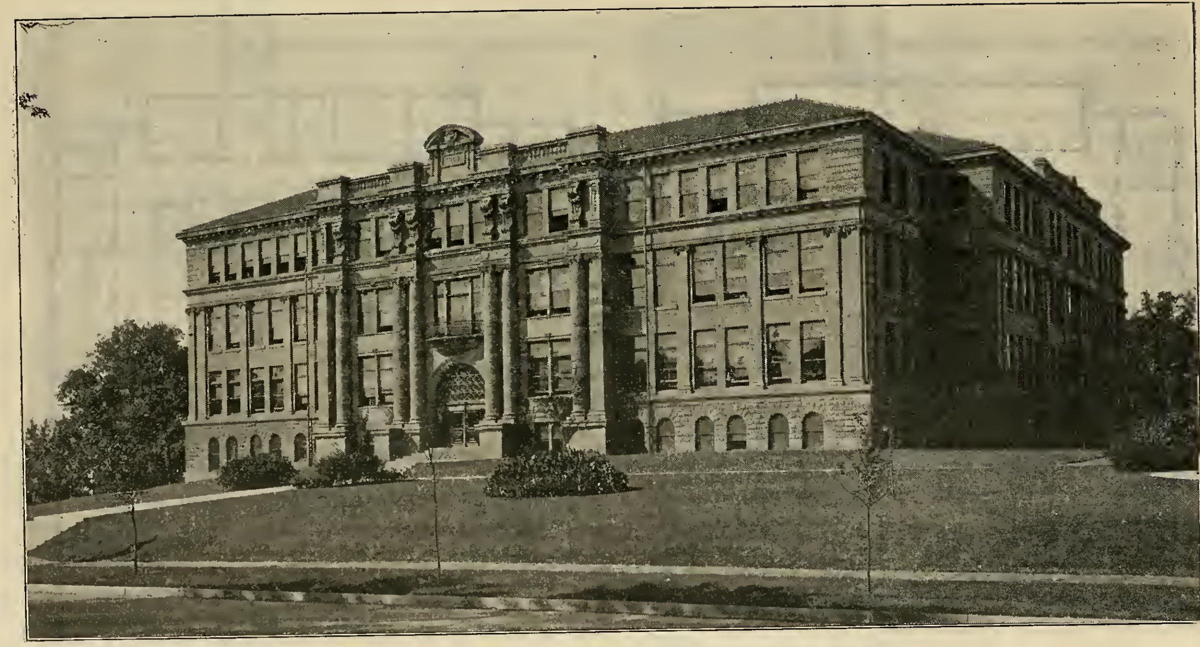
High School and Auditorium at London, Ohio. Wilbur T. Mills, Architect, Columbus, Ohio.
Fireproof. Cost 16c per cu. ft.



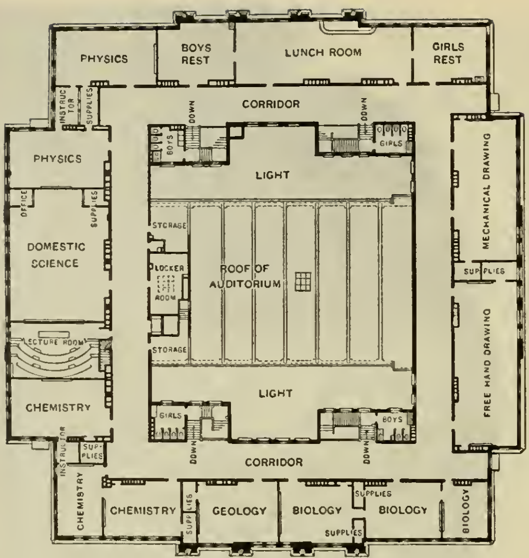
DAVENPORT HIGH SCHOOL. FIRST-FLOOR PLAN.



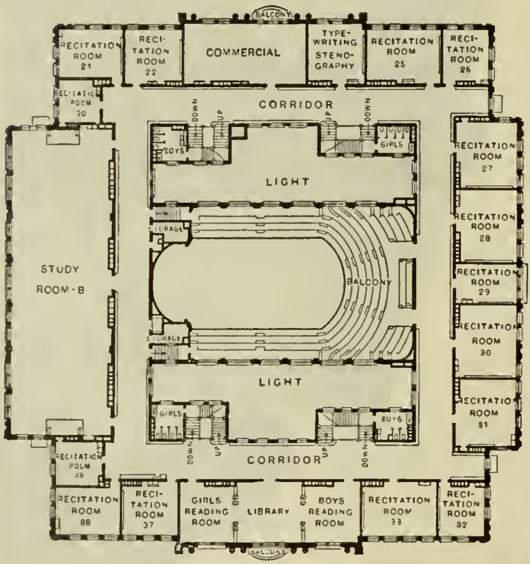
DAVENPORT HIGH SCHOOL. BASEMENT PLAN.



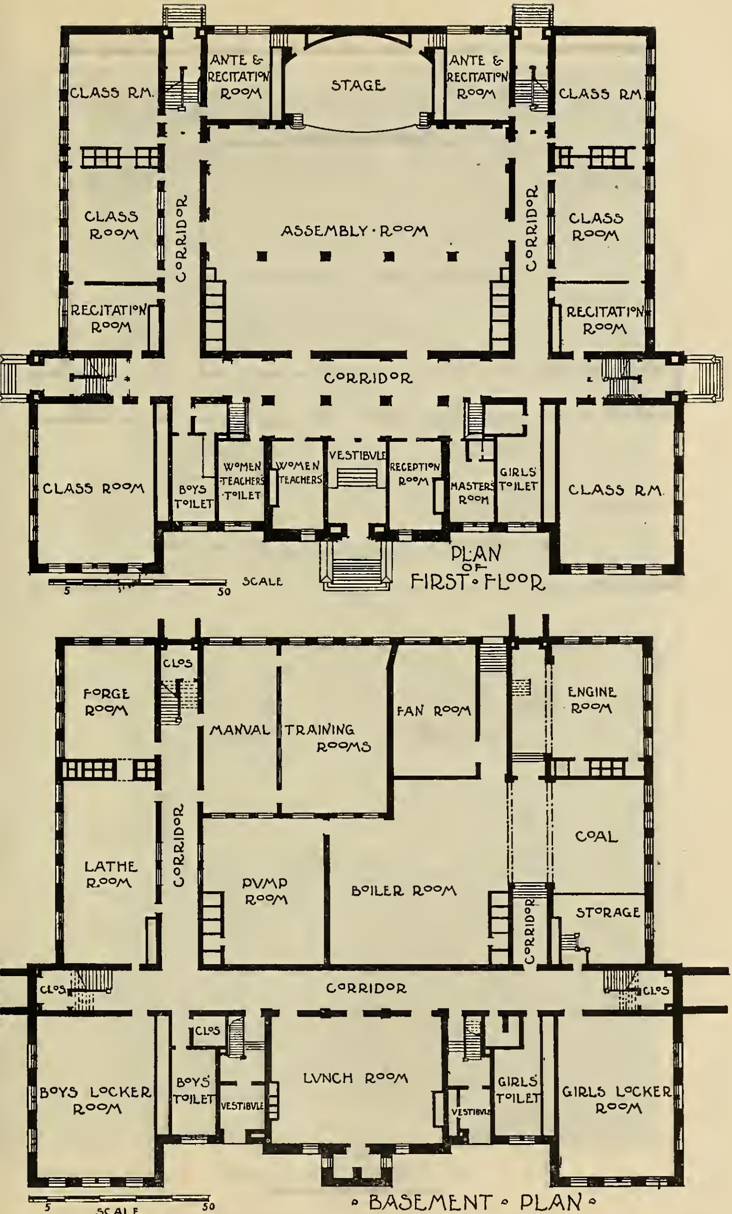
High School at Davenport, Iowa. T. G. Clausen and P. T. Burrows, Architects.



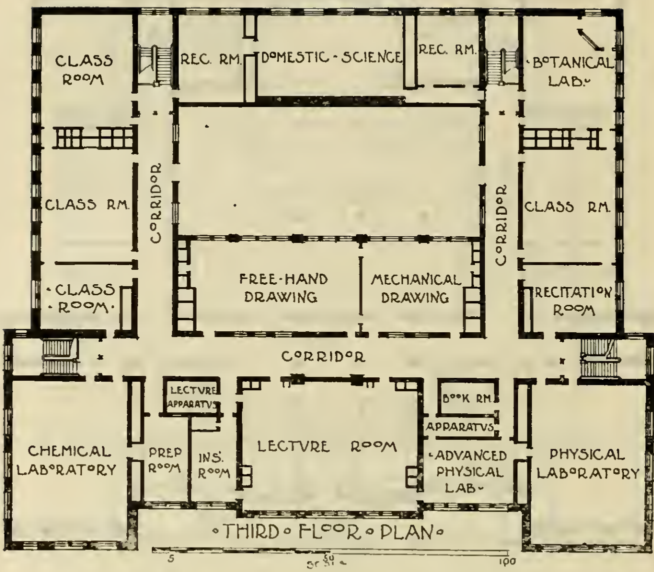
DAVENPORT HIGH SCHOOL. THIRD-FLOOR PLAN.

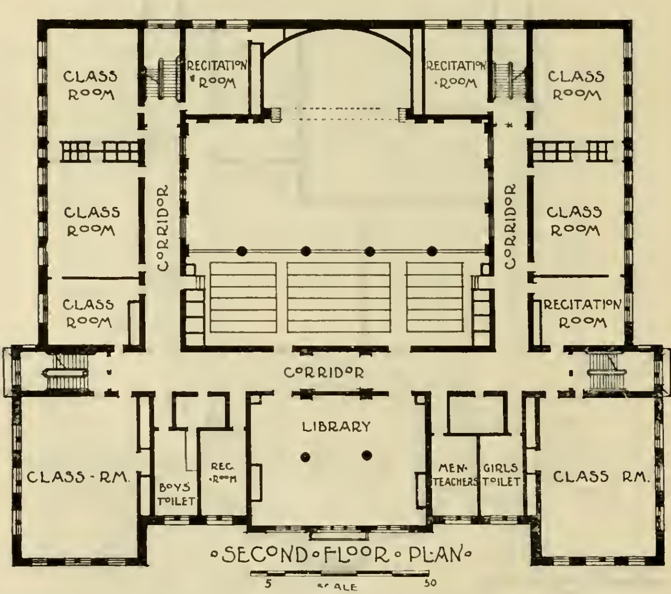


DAVENPORT HIGH SCHOOL. SECOND-FLOOR PLAN.

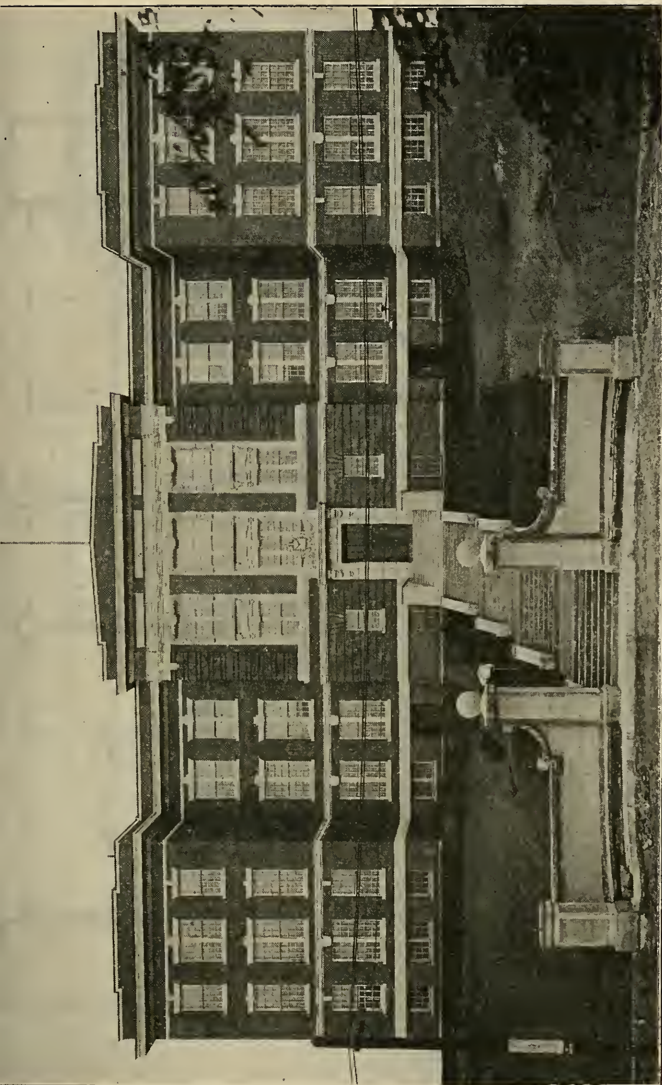


High School at Salem, Mass. Kilham and Hopkins, Architects, Boston.

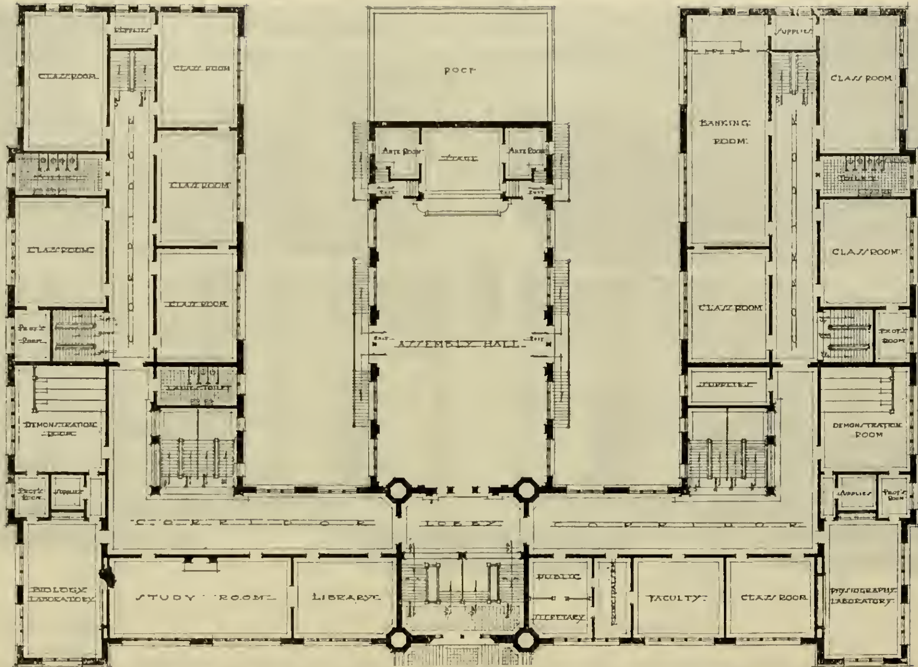




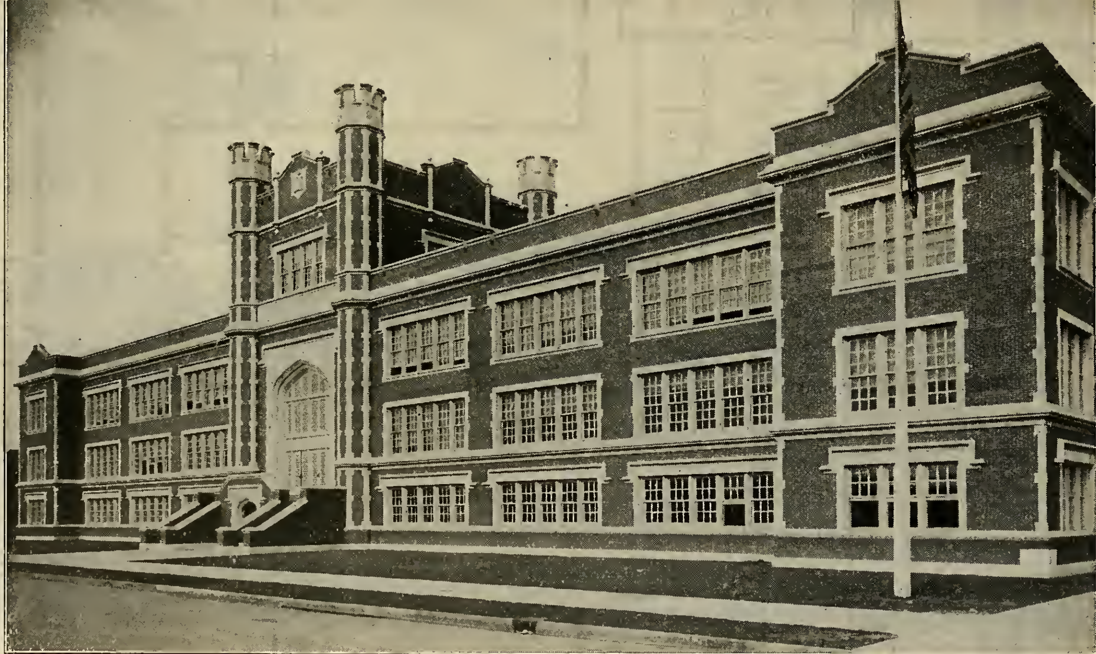
High School at Salem, Mass. Kilham and Hopkins, Architects, Boston.



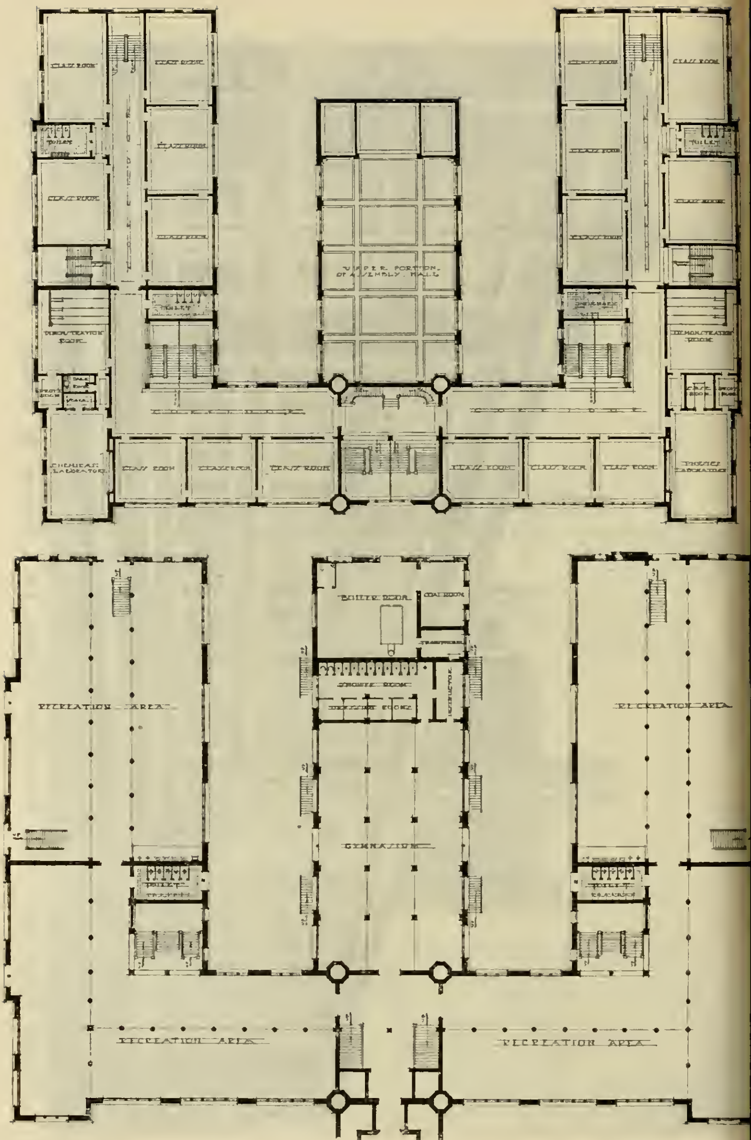
High School at Salem, Mass. Kilham and Hopkins, Architects, Boston, Mass.



Warren Easton High School, New Orleans, La. Plan of First Floor

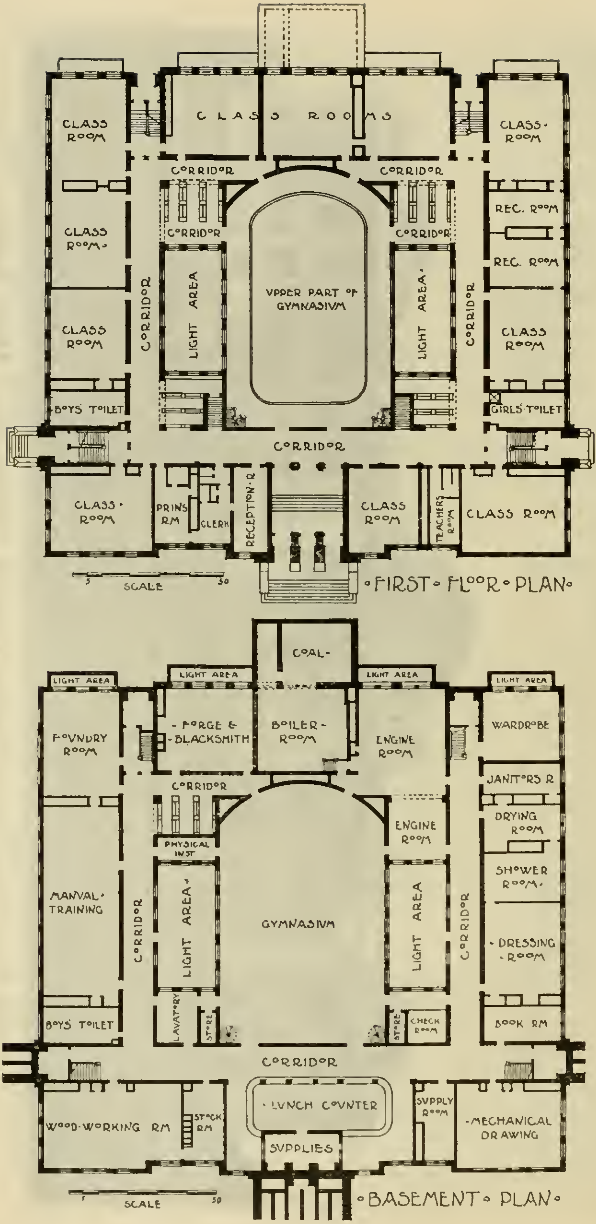


Warren Easton Boys' High School, New Orleans, La. Edward A. Christy, Architect, New Orleans.



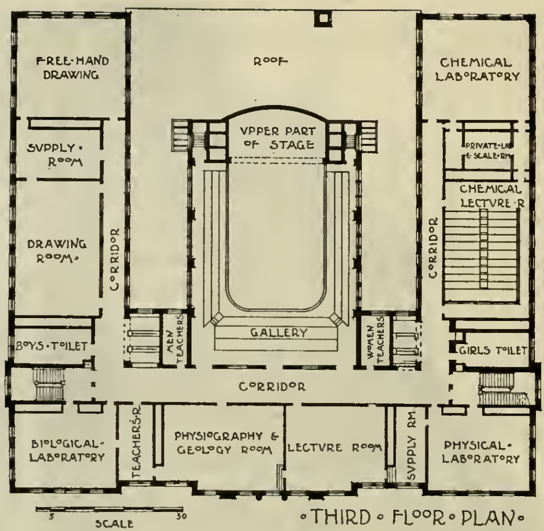
Warren Easton Boys' High School, New Orleans, La. E. A. Christy, Archite
Plan of Basement and Second Floor.

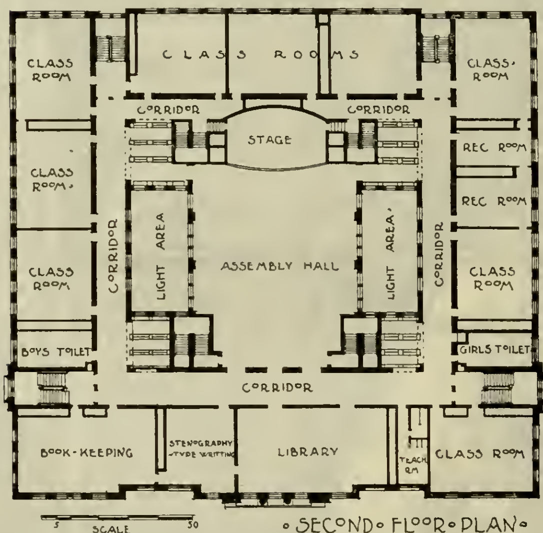
High School Group, Central Building, Pasadena, California. N. F. Marsh, Architect.



High School at Haverhill, Mass. Kilham and Hopkins, Architects, Boston.

High School at Haverhill, Mass. Kilham and Hopkins, Architects, Boston, Mass.



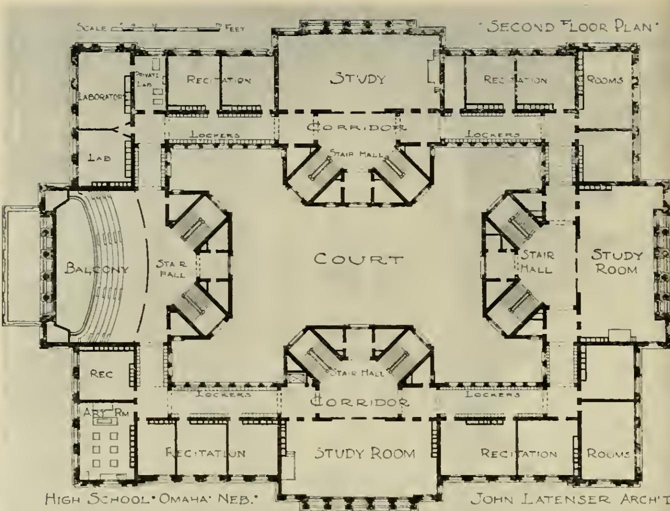


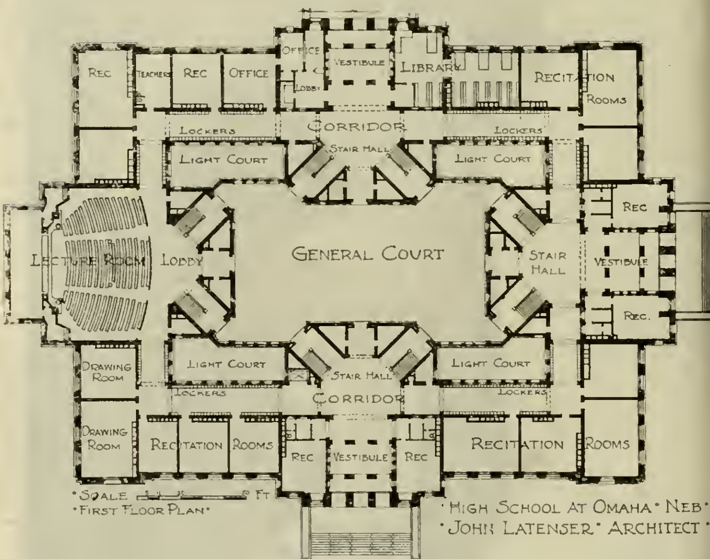
High School at Haverhill, Mass. Kilham and Hopkins, Architects, Boston.

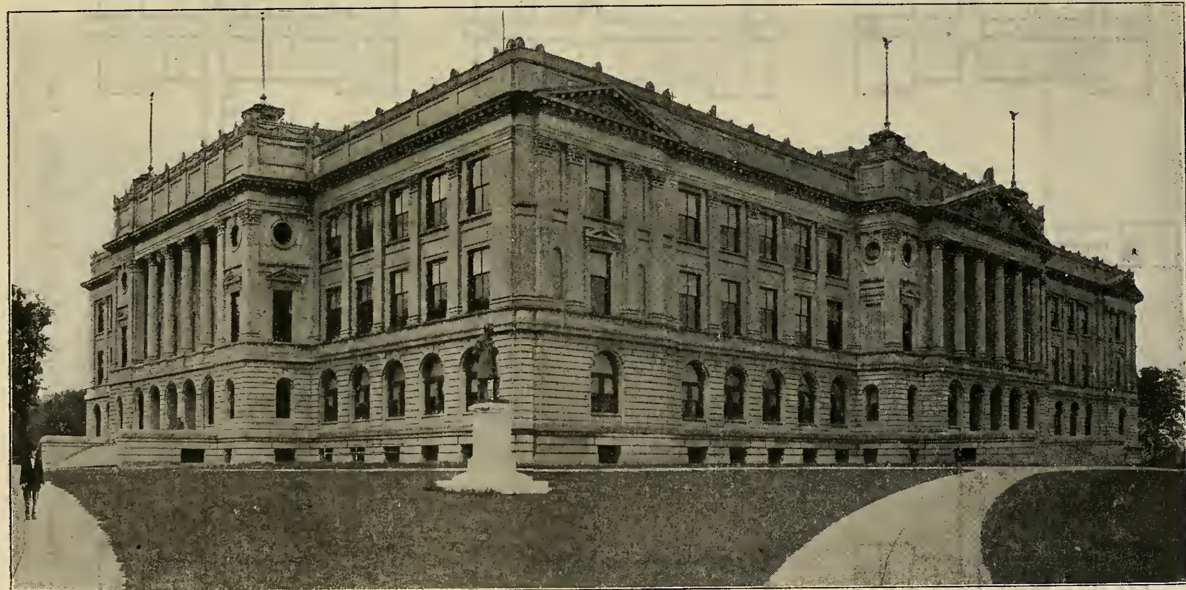
Birds' Eye View of Lincoln High School Buildings and Grounds, Los Angeles, Cal. Edgar H. Cline, Architect, Los Angeles, (of Needham & Cline.)

Lincoln High School, Los Angeles, Cal. Edgar H. Cline, Architect, Los Angeles.

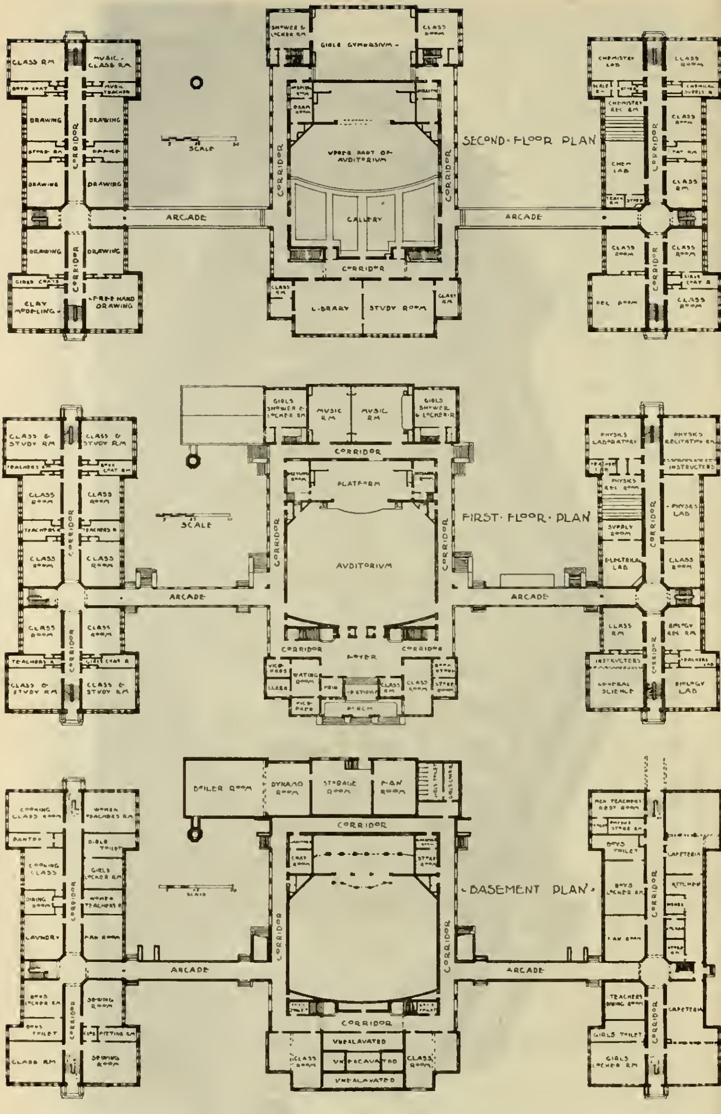
Lincoln High School, Los Angeles, Cal. Edgar H. Cline, Architect, of Needham & Cline. Los Angeles.


SCALE FEET
SECOND FLOOR PLAN
LABORATORY
PRIVATE LAB
RECITATION
STUDY
RECITATION
ROOMS
CORRIDOR
LOCKERS
LOCKERS
STAIR HALL
LAB
BALCONY
STAIR HALL
COURT
STAIR HALL
STUDY ROOM
REC
STAIR HALL
LOCKERS
CORRIDOR
LOCKERS
ART RM
RECITATION
STUDY ROOM
RECITATION
ROOMS
HIGH SCHOOL · OMAHA · NEB.
JOHN LATENSER ARCH'T


OFFICE
VESTIBULE
LIBRARY
LOBBY
REC
TEACHERS
REC
OFFICE
RECITATION
ROOMS
CORRIDOR
LOCKERS
LOCKERS
STAIR HALL
LIGHT COURT
LIGHT COURT
REC
LECTURE ROOM
LOBBY
GENERAL COURT
STAIR HALL
VESTIBULE
REC.
DRAWING ROOM
LIGHT COURT
STAIR HALL
LIGHT COURT
LOCKERS
CORRIDOR
LOCKERS
DRAWING ROOM
RECITATION
ROOMS
REC
VESTIBULE
REC
RECITATION
ROOMS
SCALE FT
FIRST FLOOR PLAN
HIGH SCHOOL AT OMAHA · NEB ·
JOHN LATENSER · ARCHITECT ·



High School at Omaha, Neb. John Latenser, Architect, Omaha.



Manual Training High School, Los Angeles, Cal.

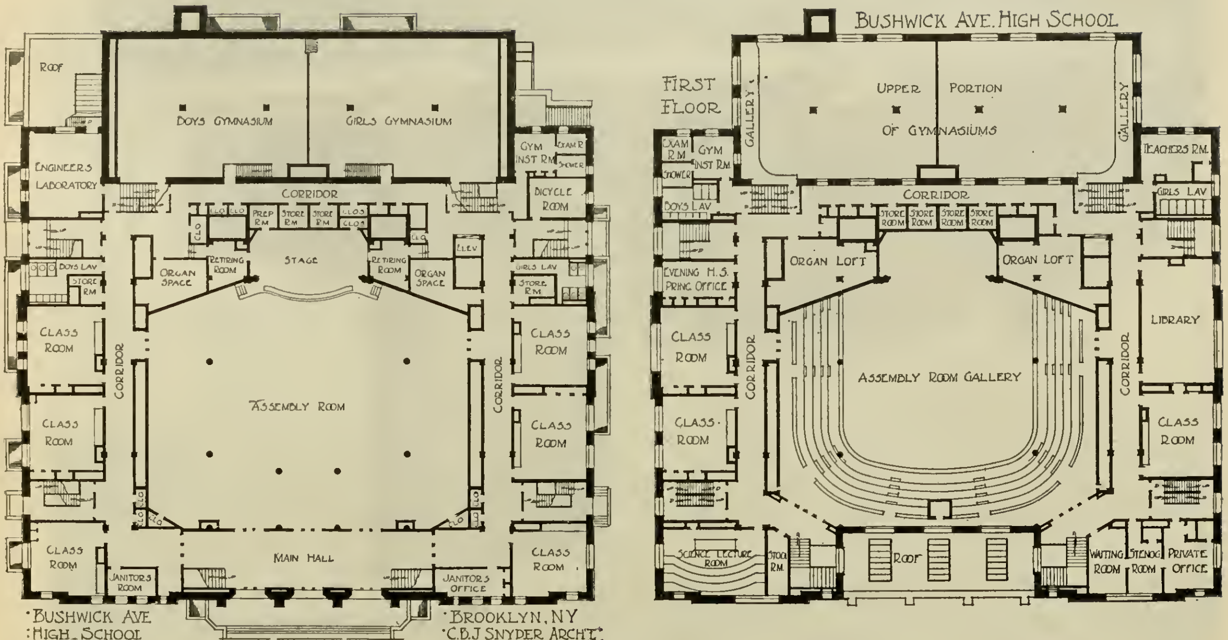
Manual Training High School, Los Angeles, California. Parkinson and Bergstrom, Architects, Los Angeles.

Rear of Administration Building, Manual Training High School, Los Angeles, Cal. Parkinson and Bergstrom, Architects.

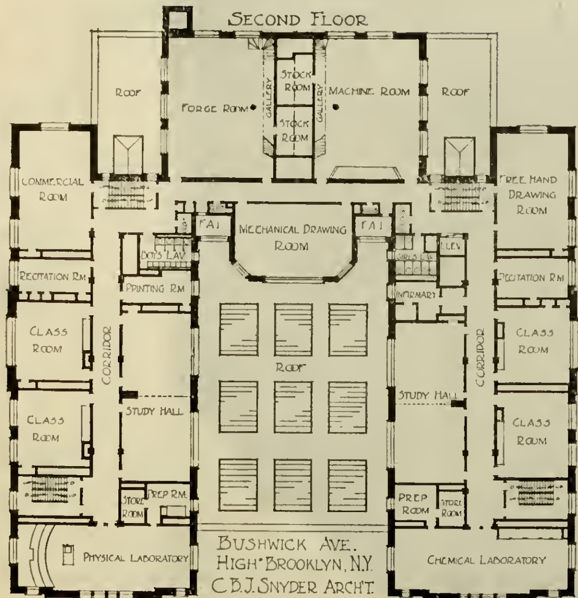
Administration Building, Manual Training High School, Los Angeles, Cal. Parkinson and Bergstrom, Architects, Los Angeles.

General Science Building. Manual Training High School, Los Angeles.

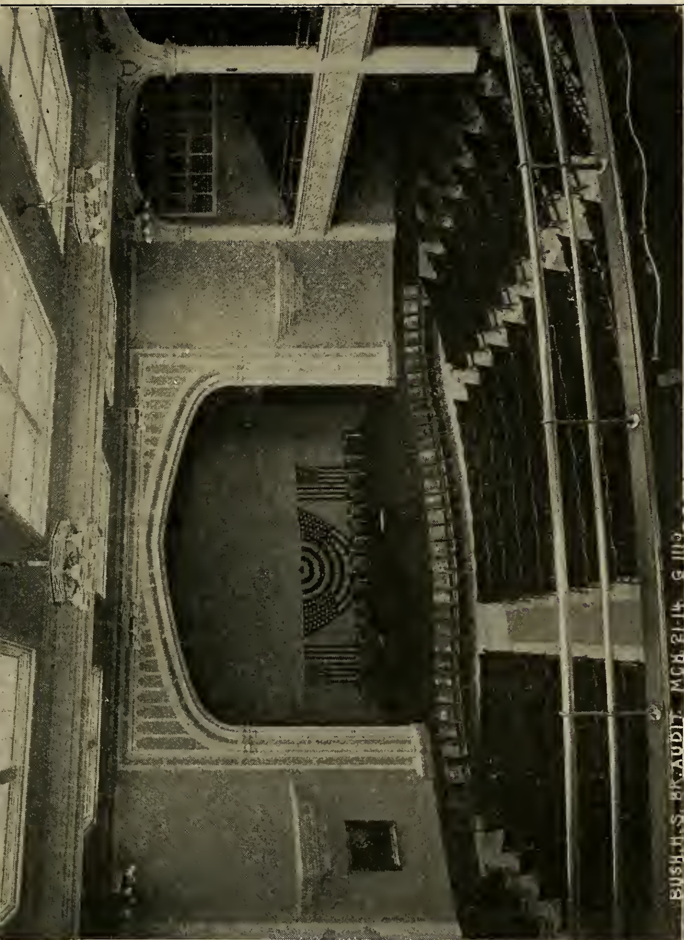
Hughes High School, Cincinnati, Ohio. J. Walter Stephens, Architect, St. Paul, Minn.


BUSHWICK AVE. HIGH SCHOOL
FIRST FLOOR
ROOF
BOYS GYMNASIUM
GIRLS GYMNASIUM
ENGINEERS LABORATORY
CORRIDOR
PREP RM
STORE RM
STORE RM
CLO
STAGE
RETIRING ROOM
ORGAN SPACE
ELEV
GYM INST RM
EXAM R
SHOWER
DICYCLE ROOM
BOYS LAV
STORE RM
GIRLS LAV
CLASS ROOM
ASSEMBLY ROOM
MAIN HALL
JANITORS ROOM
JANITORS OFFICE
·BUSHWICK AVE
:HIGH_SCHOOL
·BROOKLYN, NY
·C.B.J SNYDER ARCHT.
UPPER PORTION OF GYMNASIUMS
GALLERY
EXAM RM
SHOWER
TEACHERS RM.
STORE ROOM
ORGAN LOFT
EVENING H.S. PRINC OFFICE
LIBRARY
ASSEMBLY ROOM GALLERY
SCIENCE LECTURE ROOM
STOCK RM.
WAITING ROOM
STENOG ROOM
PRIVATE OFFICE

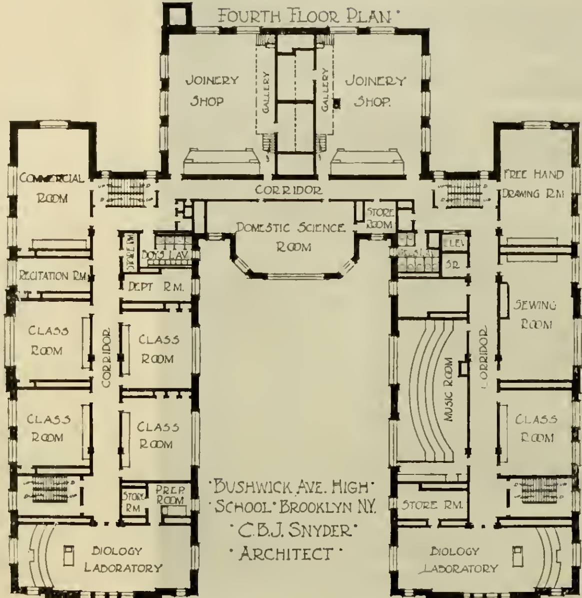
Bushwick Avenue High School, Brooklyn, New York. C. B. J. Snyder, Architect.

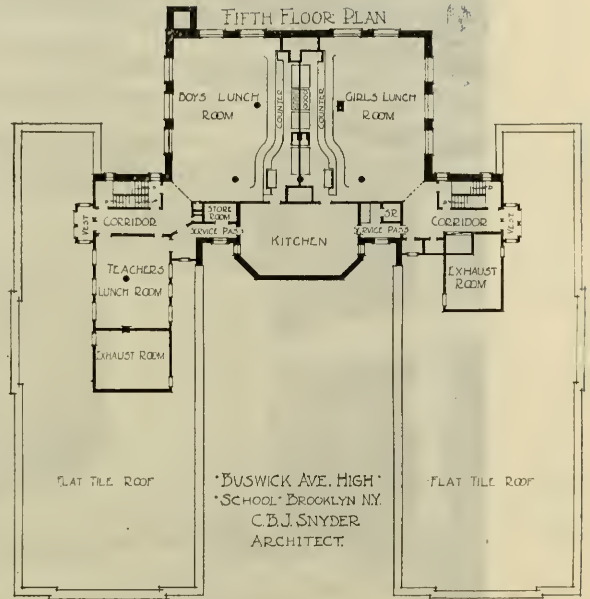

SECOND FLOOR
ROOF
FORGE ROOM
GALLERY
STOCK ROOM
STOCK ROOM
GALLERY
MACHINE ROOM
ROOF
COMMERCIAL ROOM
FREE HAND DRAWING ROOM
F.A.I.
MECHANICAL DRAWING ROOM
F.A.I.
BOYS LAV
GIRLS LAV
ELEV
RECITATION RM
PRINTING RM
INFIRMARY
RECITATION RM
CLASS ROOM
CORRIDOR
ROOF
CLASS ROOM
STUDY HALL
CORRIDOR
CLASS ROOM
STUDY HALL
CLASS ROOM
CLASS ROOM
STORE ROOM
PREP RM.
PREP ROOM
STORE ROOM
PHYSICAL LABORATORY
CHEMICAL LABORATORY
BUSHWICK AVE.
HIGH BROOKLYN, N.Y.
C.B.J. SNYDER ARCH'T.


THIRD FLOOR PLAN
PATTERN SHOP
TOOL ROOM
TOOL ROOM
SHEET METAL SHOP
COMMERCIAL ROOM
CORRIDOR
FREE HAND DRAWING RM
TEACHERS ROOM
MECHANICAL DRAW. RM.
TEACHERS ROOM
ELEV
BOYS LAV
GIRLS LAV
RECITATION ROOM
DEPT RM.
DEPT. RM.
RECITATION ROOM
CLASS ROOM
CORRIDOR
CLASS ROOM
CLASS ROOM
CORRIDOR
CLASS ROOM
CLASS ROOM
CLASS ROOM
CLASS ROOM
CLASS ROOM
BUSHWICK AVE. HIGH
SCHOOL BROOKLYN N.Y.
C.B. SNYDER
ARCHITECT
STORE RM
PREP RM.
PREP RM
STORE RM.
PHYSICAL LAB.
CHEMICAL LAB.



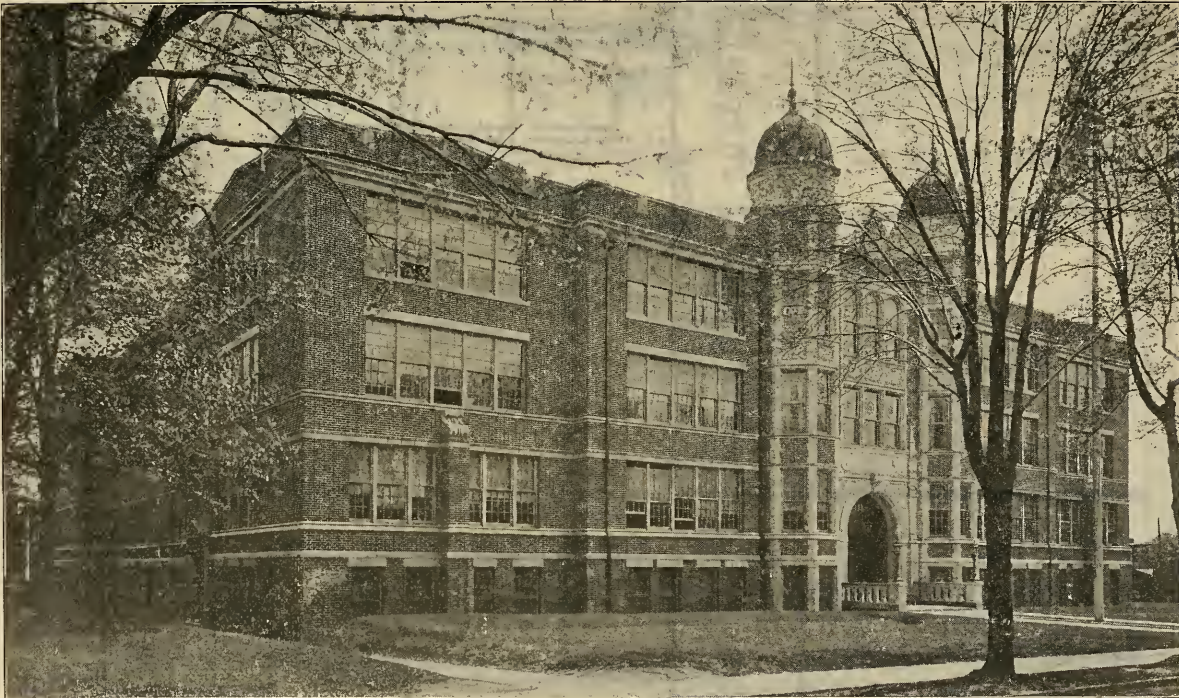
Auditorium, Bushwick Avenue High School, Brooklyn, New York.


FOURTH FLOOR PLAN
JOINERY SHOP
GALLERY
GALLERY
JOINERY SHOP
COMMERCIAL ROOM
CORRIDOR
FREE HAND DRAWING RM
STORE ROOM
DOMESTIC SCIENCE ROOM
BOYS LAV
STORE RM
ELEV
SR
RECITATION RM
DEPT RM.
CLASS ROOM
CORRIDOR
CLASS ROOM
SEWING ROOM
MUSIC ROOM
CORRIDOR
CLASS ROOM
CLASS ROOM
CLASS ROOM
STORE RM
PREP ROOM
STORE RM.
BIOLOGY LABORATORY
BIOLOGY LABORATORY
·BUSHWICK AVE. HIGH·
·SCHOOL· BROOKLYN NY.
·C.B.J. SNYDER·
·ARCHITECT·

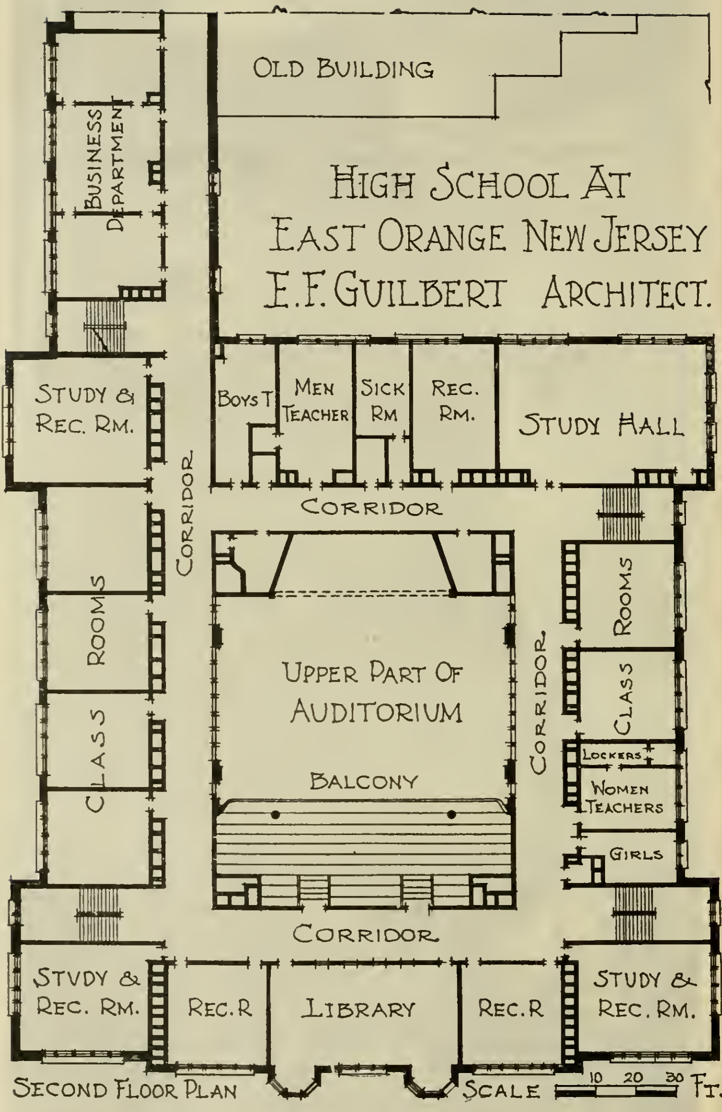

FIFTH FLOOR PLAN
BOYS LUNCH ROOM
COUNTER
COUNTER
GIRLS LUNCH ROOM
VEST
CORRIDOR
STORE ROOM
SERVICE PASS
KITCHEN
SERVICE PASS
SR
CORRIDOR
VEST
TEACHERS LUNCH ROOM
EXHAUST ROOM
EXHAUST ROOM
FLAT TILE ROOF
FLAT TILE ROOF
·BUSWICK AVE. HIGH·
·SCHOOL· BROOKLYN NY.
C.B.J. SNYDER
ARCHITECT.

West Philadelphia High School, Philadelphia, Pa. J. Horace Cook, Architect.

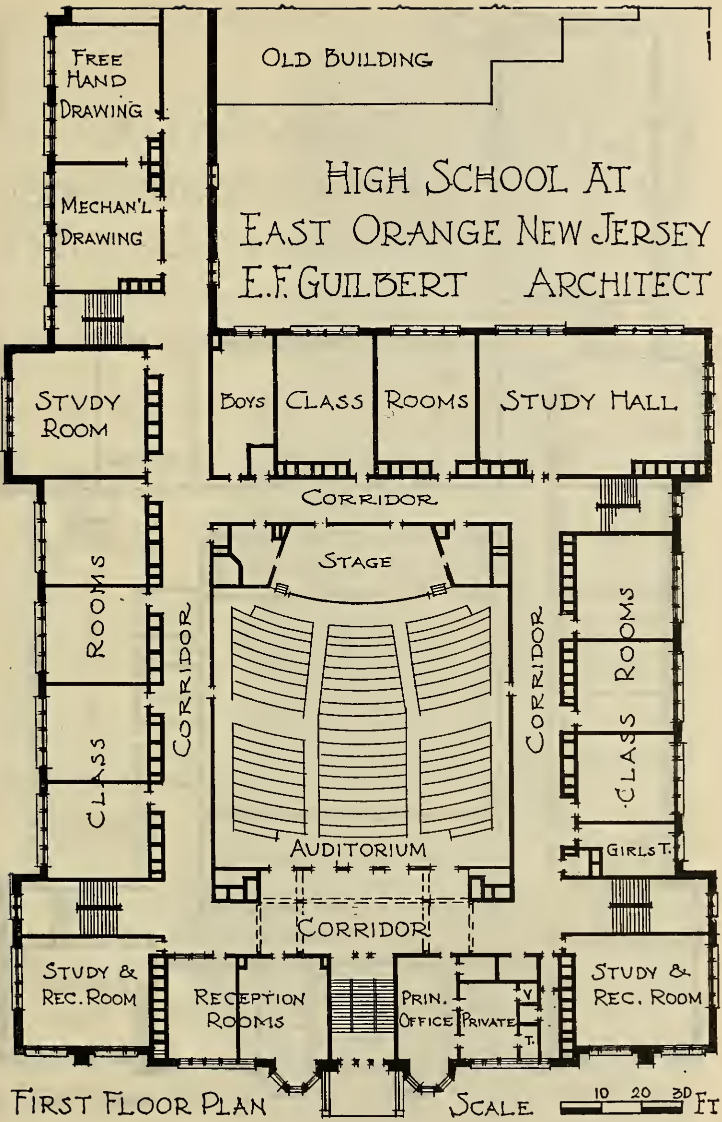
East Technical High School, Cleveland, O. F. S. Barnum, Architect.

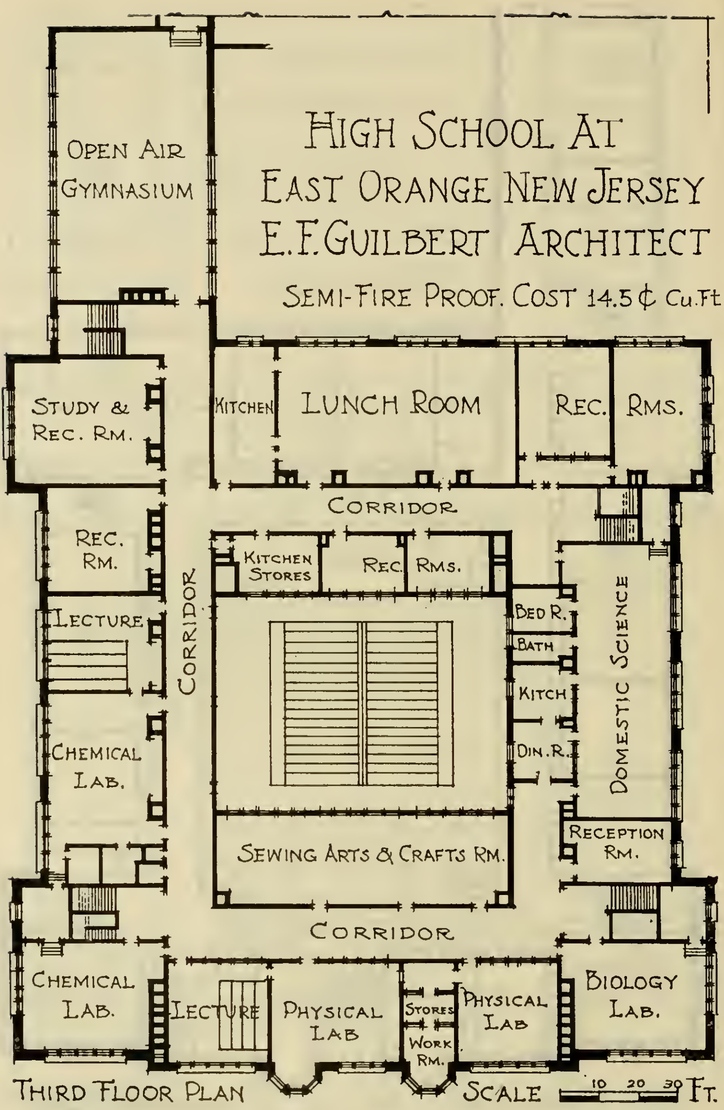


High School at East Orange, N. J. E. F. Guilbert, Architect, Newark, New Jersey.



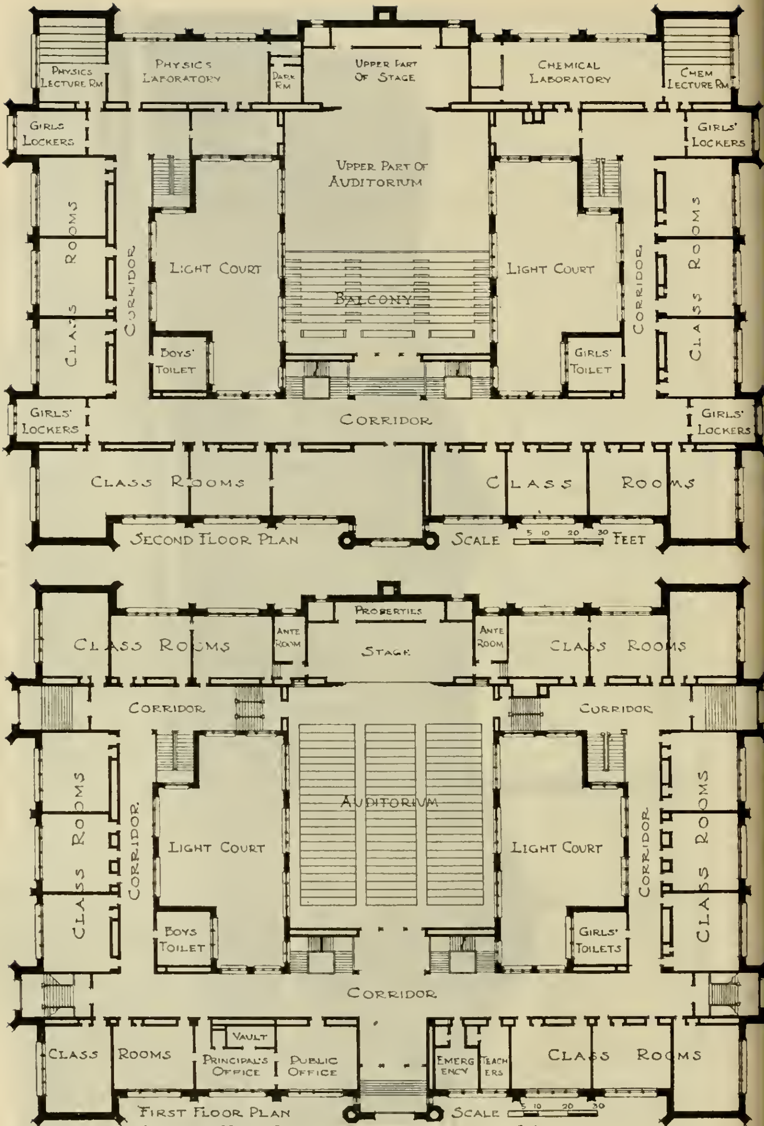
OLD BUILDING
HIGH SCHOOL AT
EAST ORANGE NEW JERSEY
E.F. GUILBERT ARCHITECT.
BUSINESS DEPARTMENT
STUDY & REC. RM.
CORRIDOR
BOYS T.
MEN TEACHER
SICK RM
REC. RM.
STUDY HALL
CORRIDOR
CLASS ROOMS
UPPER PART OF AUDITORIUM
BALCONY
CORRIDOR
CLASS ROOMS
LOCKERS
WOMEN TEACHERS
GIRLS
CORRIDOR
STUDY & REC. RM.
REC. R
LIBRARY
REC. R
STUDY & REC. RM.
SECOND FLOOR PLAN
SCALE 10 20 30 FT.


OLD BUILDING
HIGH SCHOOL AT
EAST ORANGE NEW JERSEY
E.F. GUILBERT ARCHITECT
FREE HAND DRAWING
MECHAN'L DRAWING
STUDY ROOM
BOYS
CLASS ROOMS
STUDY HALL
CORRIDOR
STAGE
CLASS ROOMS
CORRIDOR
CORRIDOR
CLASS ROOMS
AUDITORIUM
GIRLS T.
CORRIDOR
STUDY & REC. ROOM
RECEPTION ROOMS
PRIN. OFFICE
PRIVATE
V
T.
STUDY & REC. ROOM
FIRST FLOOR PLAN
SCALE
10 20 30 FT



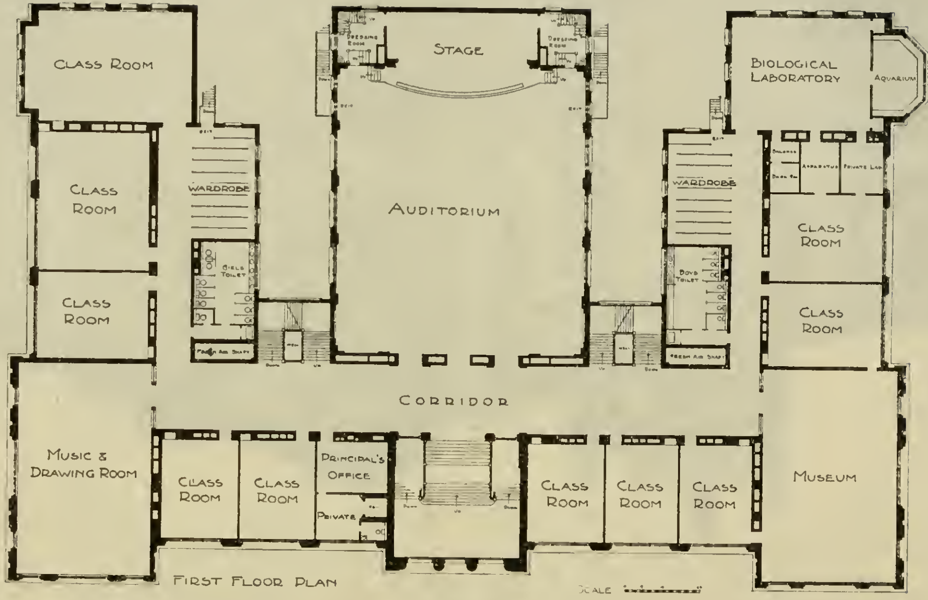
THIRD FLOOR PLAN

Jefferson High School, Portland, Ore. Cost $573,706. Slow Burning Construction.



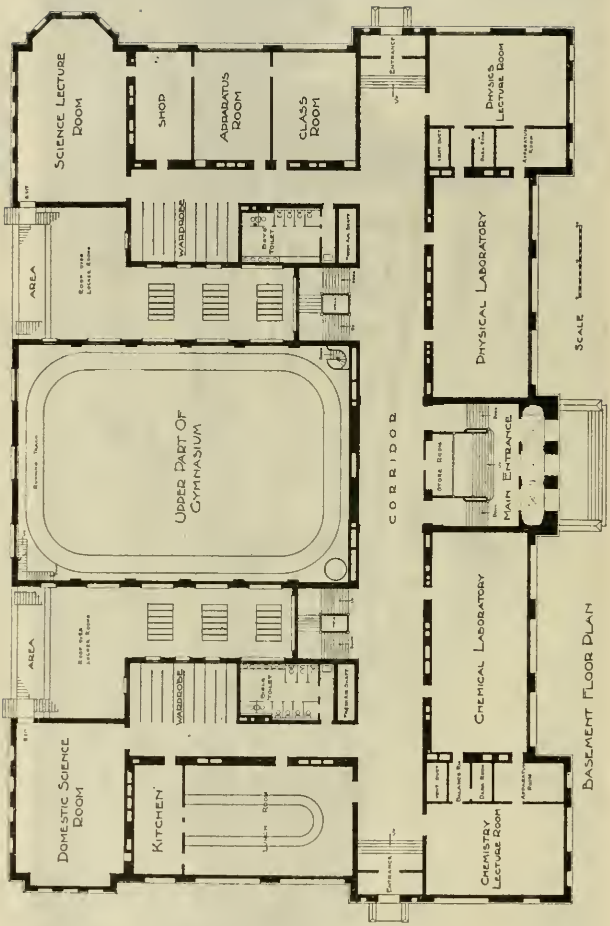
• CENTRAL HIGH SCHOOL Saint Paul, MINN • C.H. JOHNSON • ARCH •

Central High School at Minneapolis, Minn. Clarence H. Johnson, Architect, Saint Paul,

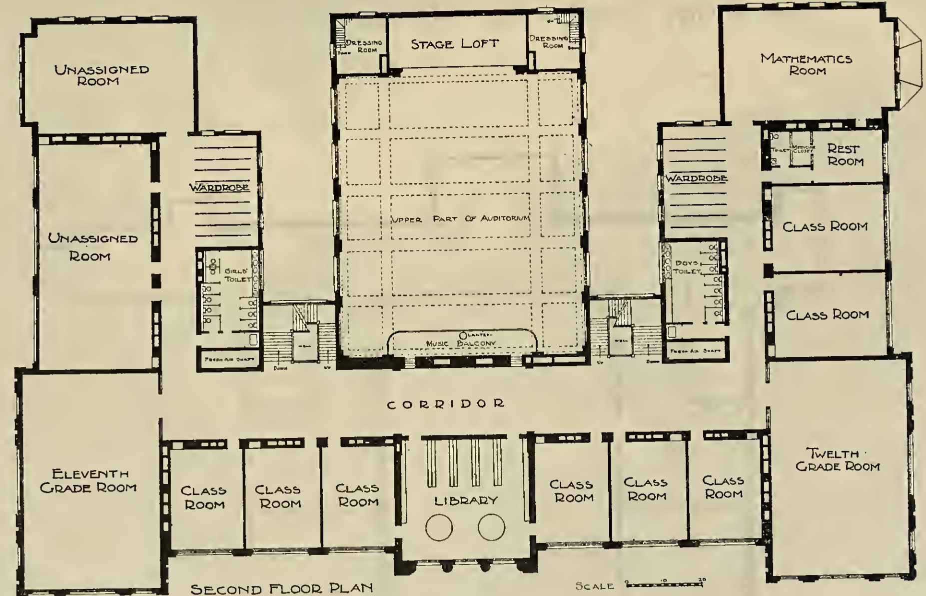


High School Building, Battle Creek, Mich. Wilbur T. Mills, Architect, Columbus, O.

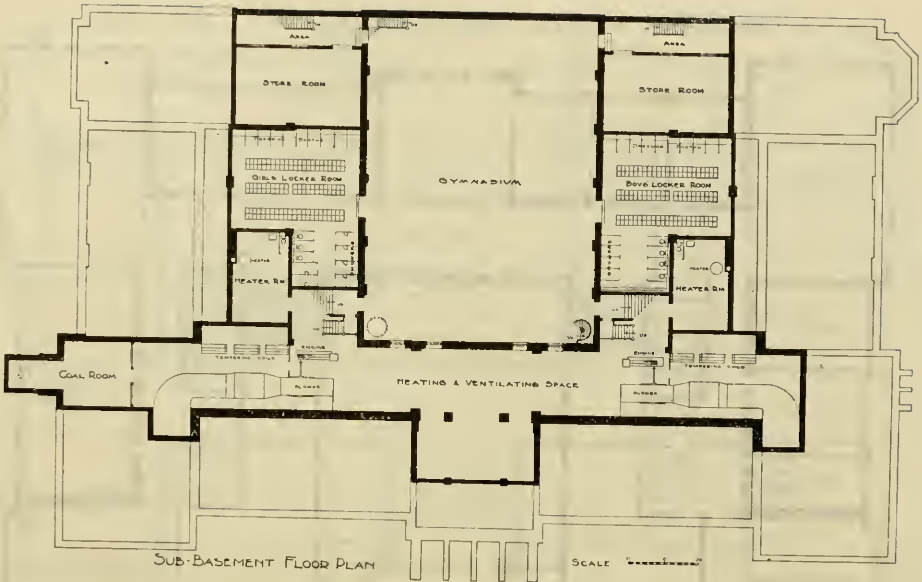
High School, Battle Creek, Mich. Wilbur T. Mills, Architect, Columbus, O.



Basement Floor Plan

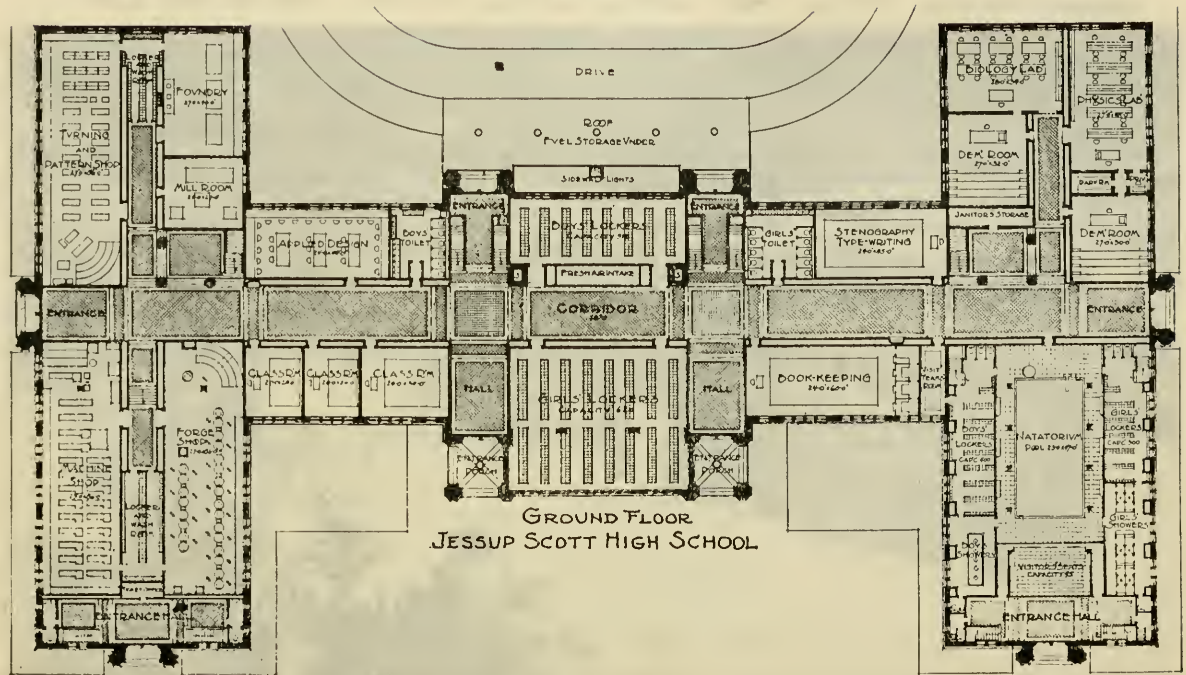


High School Building at Battle Creek, Mich. Wilbur T. Mills, Architect.

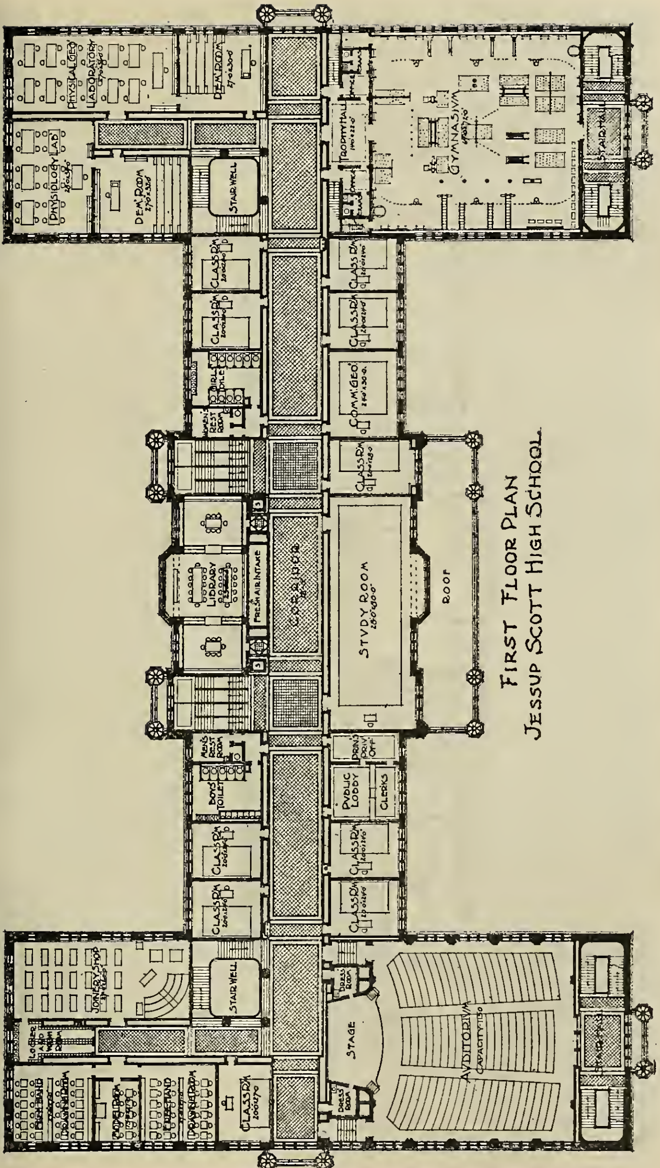


High School Building at Battle Creek, Mich. Wilbur T. Mills, Architect.

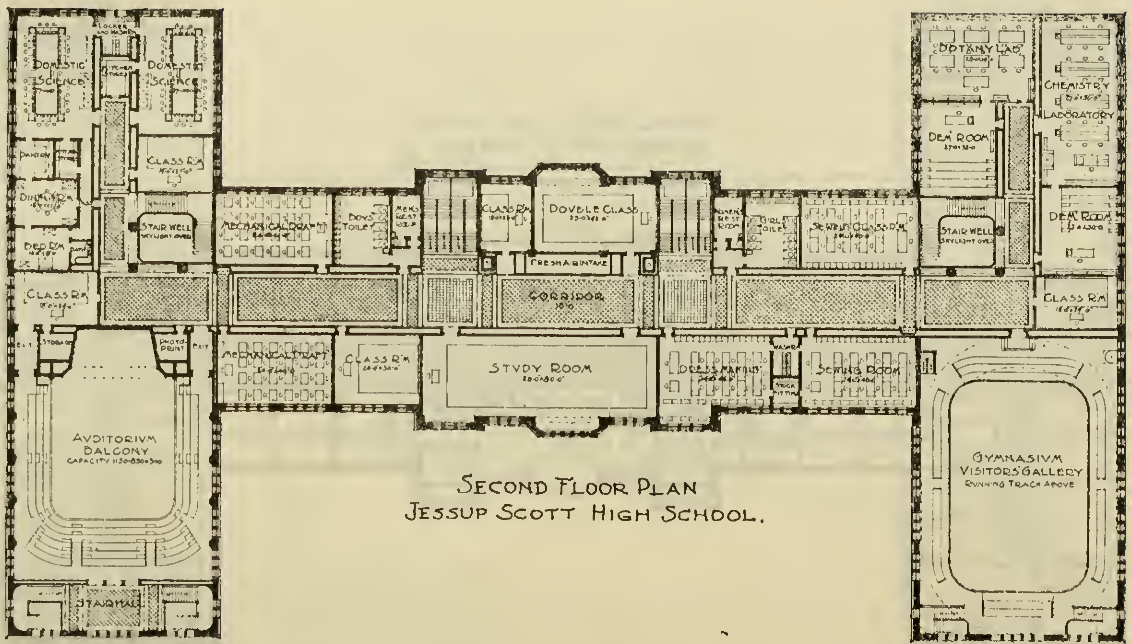
Jessup W. Scott High School, Toledo, Ohio. Charles M. Nordhoff, Architect. Fireproof. Cost about $700,000= 19.5c per cu. ft.



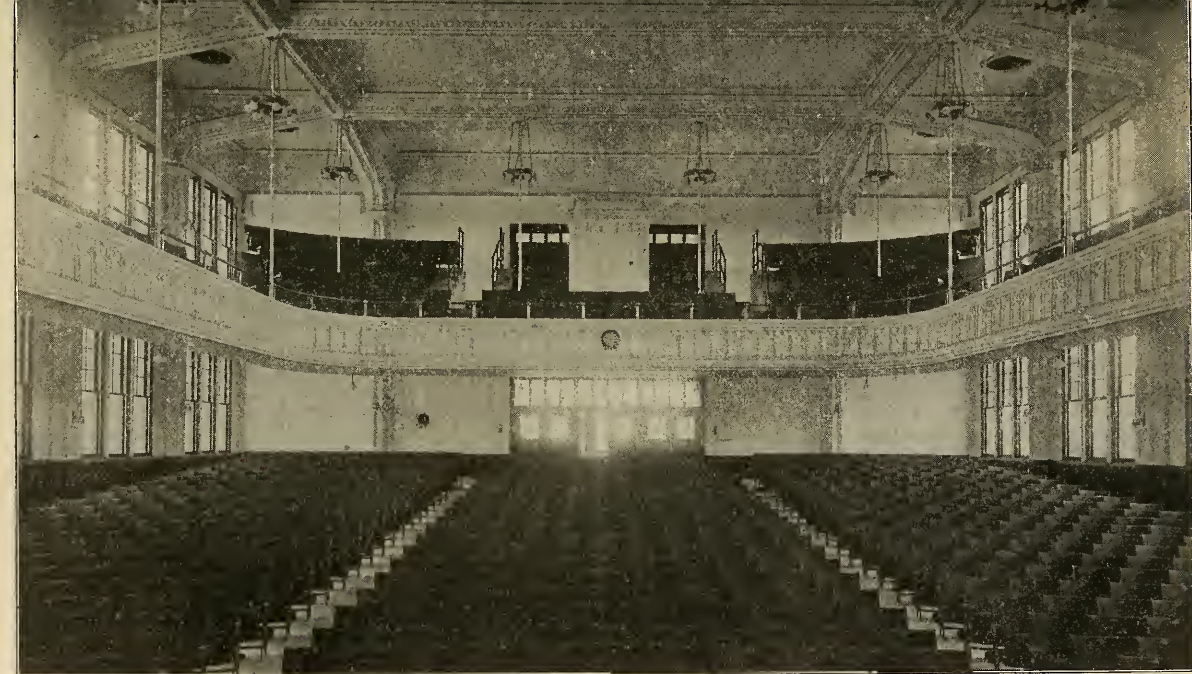
GROUND FLOOR
JESSUP SCOTT HIGH SCHOOL



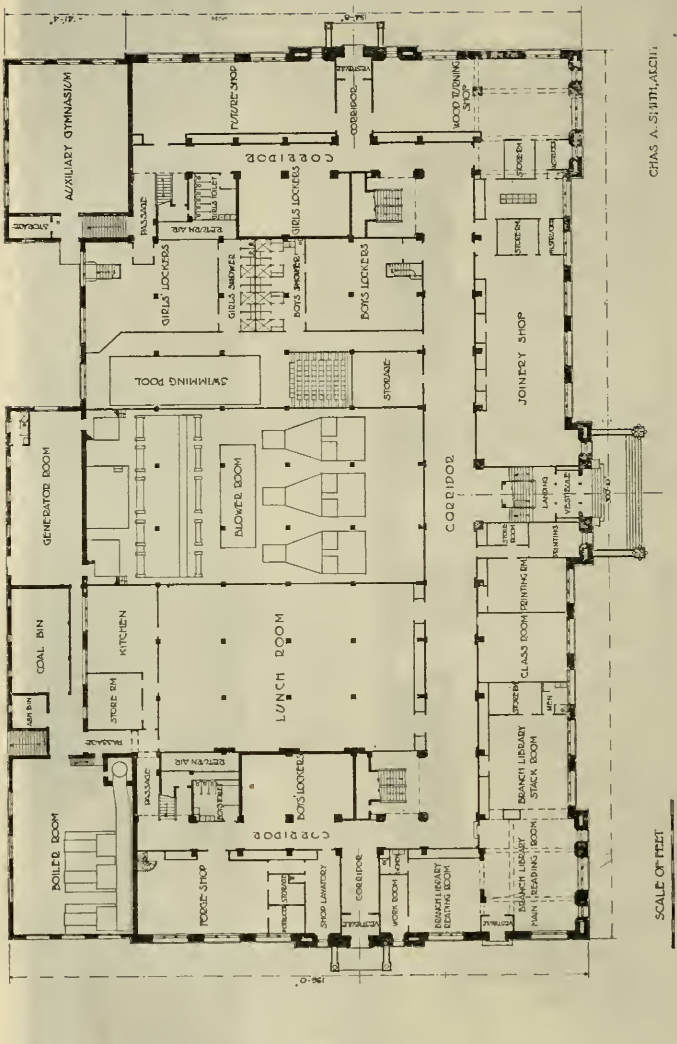
FIRST FLOOR PLAN
JESSUP SCOTT HIGH SCHOOL



SECOND FLOOR PLAN
JESSUP SCOTT HIGH SCHOOL.

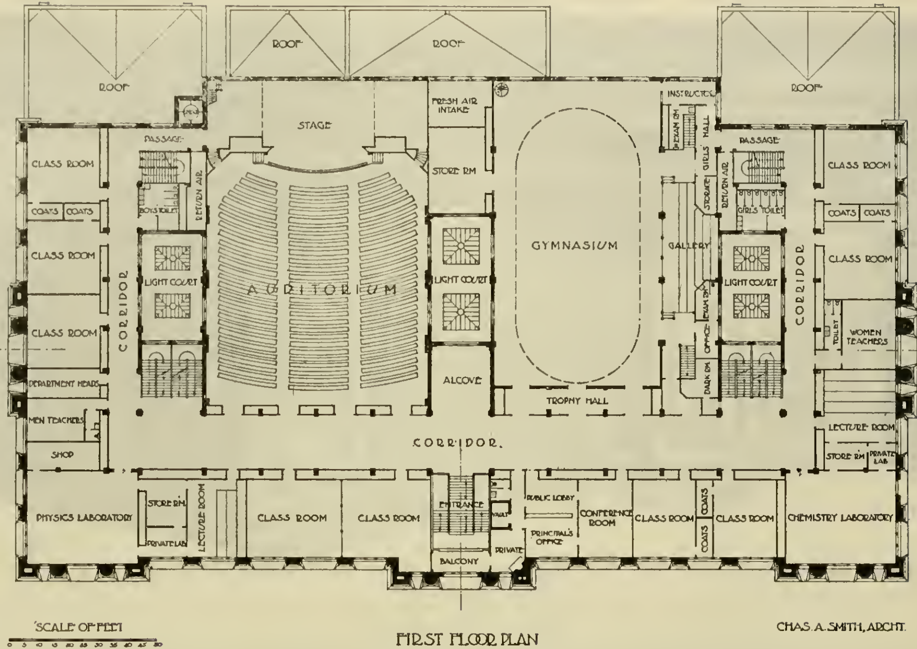


Auditorium, Jessup W. Scott High School, Toledo, Ohio. Charles M. Nordhoff, Architect.



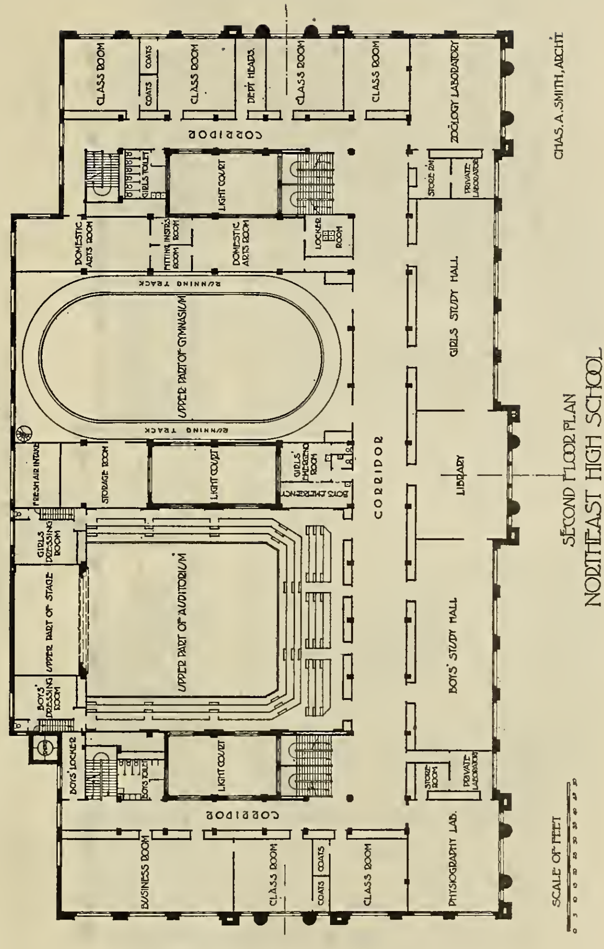
GROUND FLOOR PLAN
NORTHEAST HIGH SCHOOL

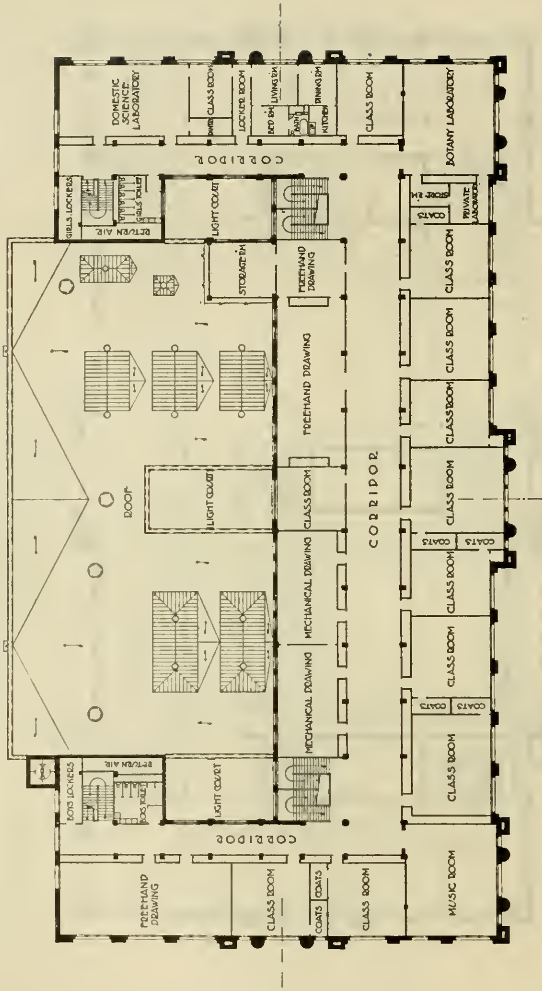
North East High School, Kansas City, Mo. Smith, Rea and Lovett, Architects. Cost $520,000=15.5c per cu. ft.



FIRST FLOOR PLAN
NORTHEAST HIGH SCHOOL

Fireproof. Capacity 1600 pupils. Cost $520,000=15.5c. per cu. ft.


CLASS ROOM
COATS
COATS
CLASS ROOM
DEPT HEADS
CLASS ROOM
CLASS ROOM
ZOÖLOGY LABORATORY
CORRIDOR
GIRLS TOILET
LIGHT COURT
DOMESTIC ARTS ROOM
FITTING INSTR'S ROOM
DOMESTIC ARTS ROOM
LOCKER ROOM
STORE RM
PRIVATE LABORATORY
RUNNING TRACK
UPPER PART OF GYMNASIUM
RUNNING TRACK
GIRLS STUDY HALL
FRESH AIR INTAKE
STORAGE ROOM
LIGHT COURT
GIRLS' EMERGENCY ROOM
BOYS' EMERGENCY
CORRIDOR
LIBRARY
GIRLS DRESSING ROOM
UPPER PART OF STAGE
UPPER PART OF AUDITORIUM
BOYS' DRESSING ROOM
BOYS' STUDY HALL
BOYS' LOCKER
BOYS TOILET
LIGHT COURT
STORE ROOM
PRIVATE LABORATORY
CORRIDOR
BUSINESS ROOM
CLASS ROOM
COATS
COATS
CLASS ROOM
PHYSIOGRAPHY LAB.
SCALE OF FEET
CHAS. A. SMITH, ARCHT.
SECOND FLOOR PLAN
NORTHEAST HIGH SCHOOL

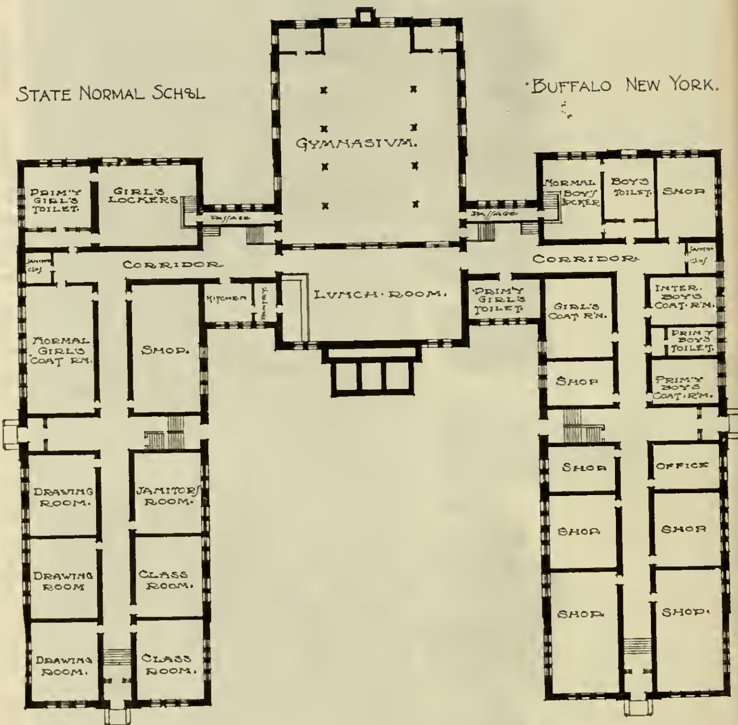


SCALE OF FEET

CHAS. A. SMITH, ARCHT.

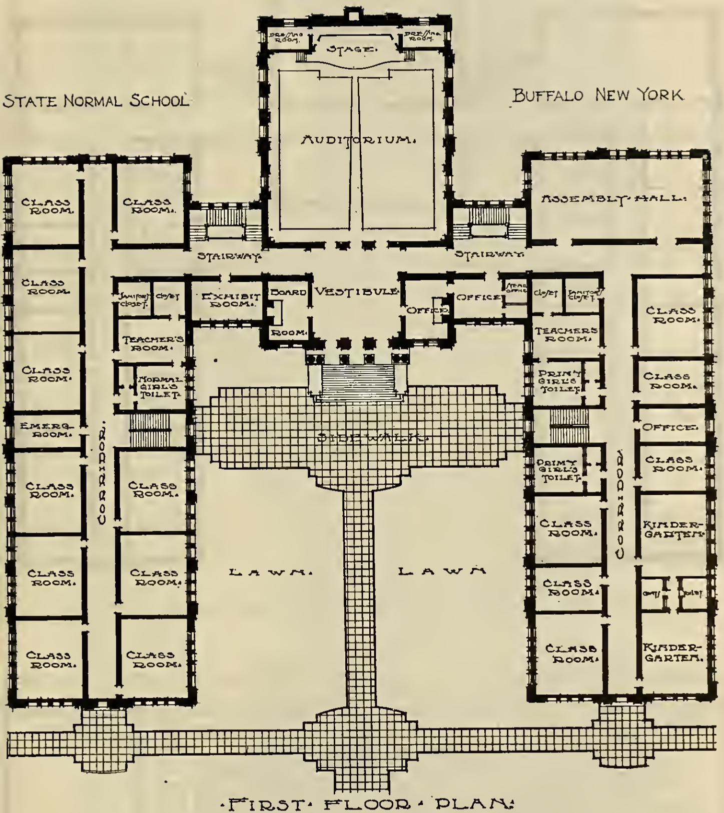
THIRD FLOOR PLAN
NORTHEAST HIGH SCHOOL

State Normal School, Buffalo, New York. Lewis F. Pilcher, State Architect. Fred B. O'Connor, Designer. Albany, N. Y.



·BASEMENT·FLOOR·PLAN·

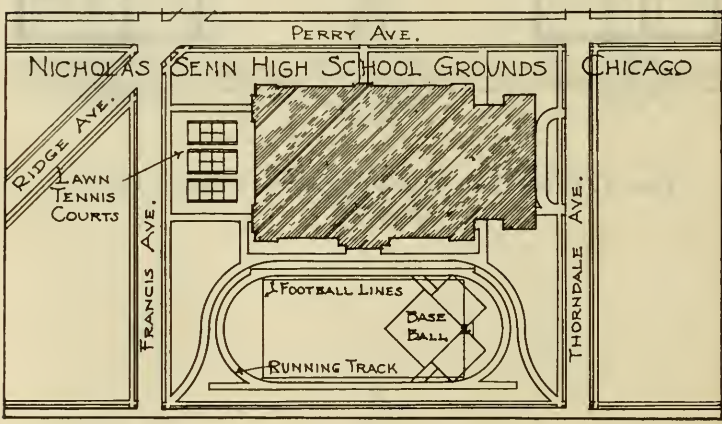
Lewis F. Pilcher, State Architect. Fred B. O'Connor, Designer
Albany, N. Y.



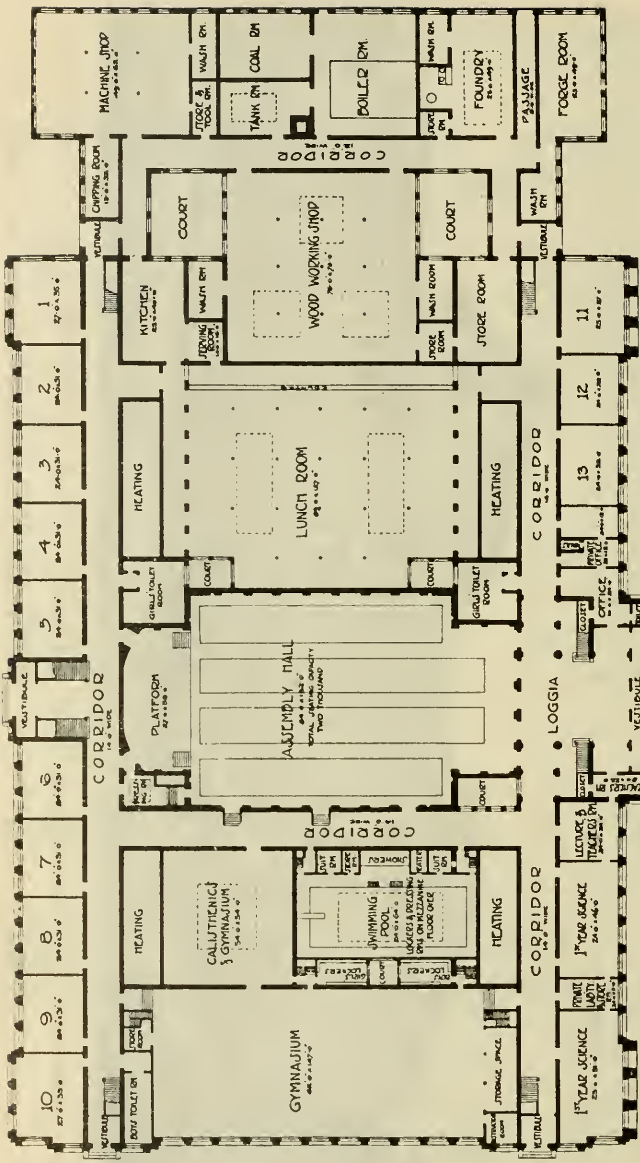
Lewis F. Pilcher, State Architect. Fred B. O'Connor, Designer.
Albany, N. Y.

·SECOND·STORY·PLAN·

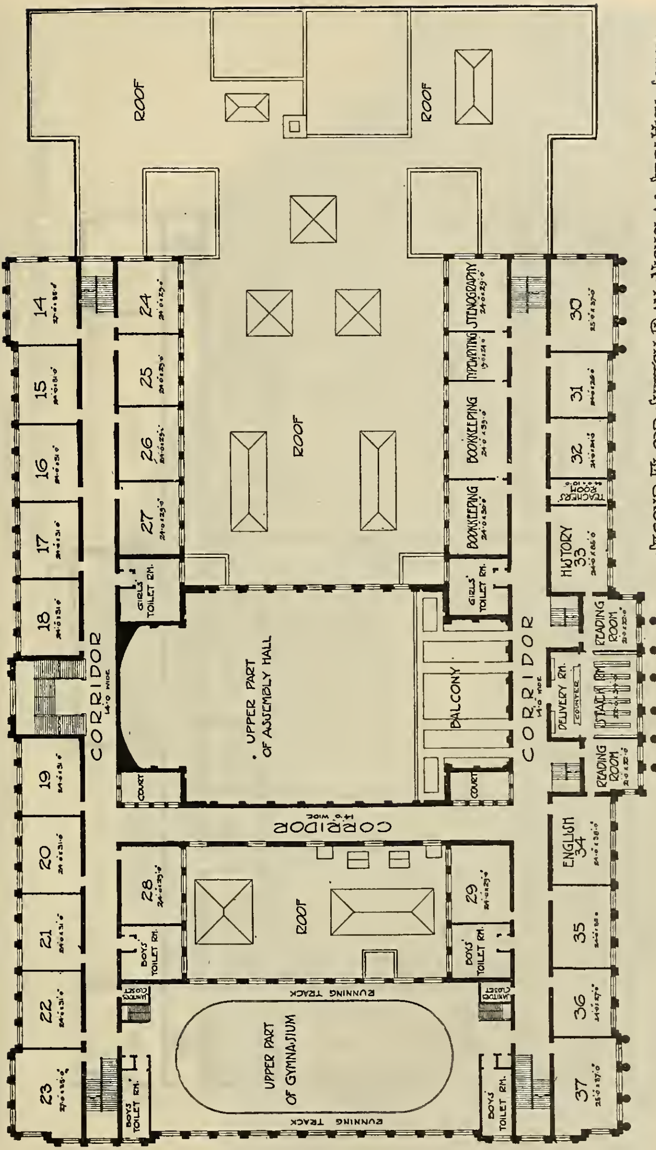
Lewis F. Pilcher, State Architect, and Fred B. O'Connor, Designer.
Albany, N. Y.



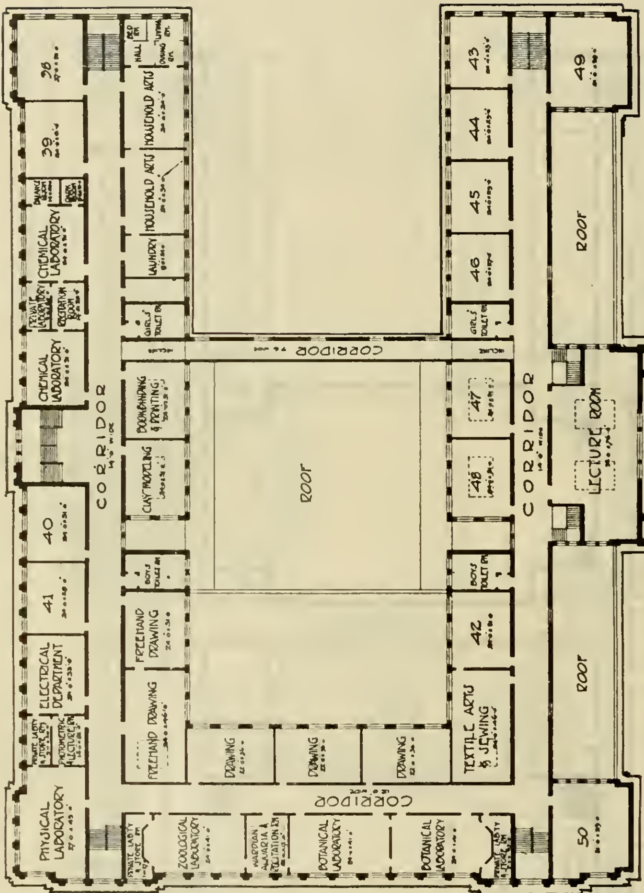
Nicholas Senn High School, Chicago, Ill. A. F. Husander, Architect. Cost $700,000, equipped=15.1c. per cu. ft.



·FIRST·FLOOR·SKETCH·PLAN·NICHOLAS·SENN·HIGH·SCHOOL·
·A.F.HUSSANDER· ·ARCHITECT·

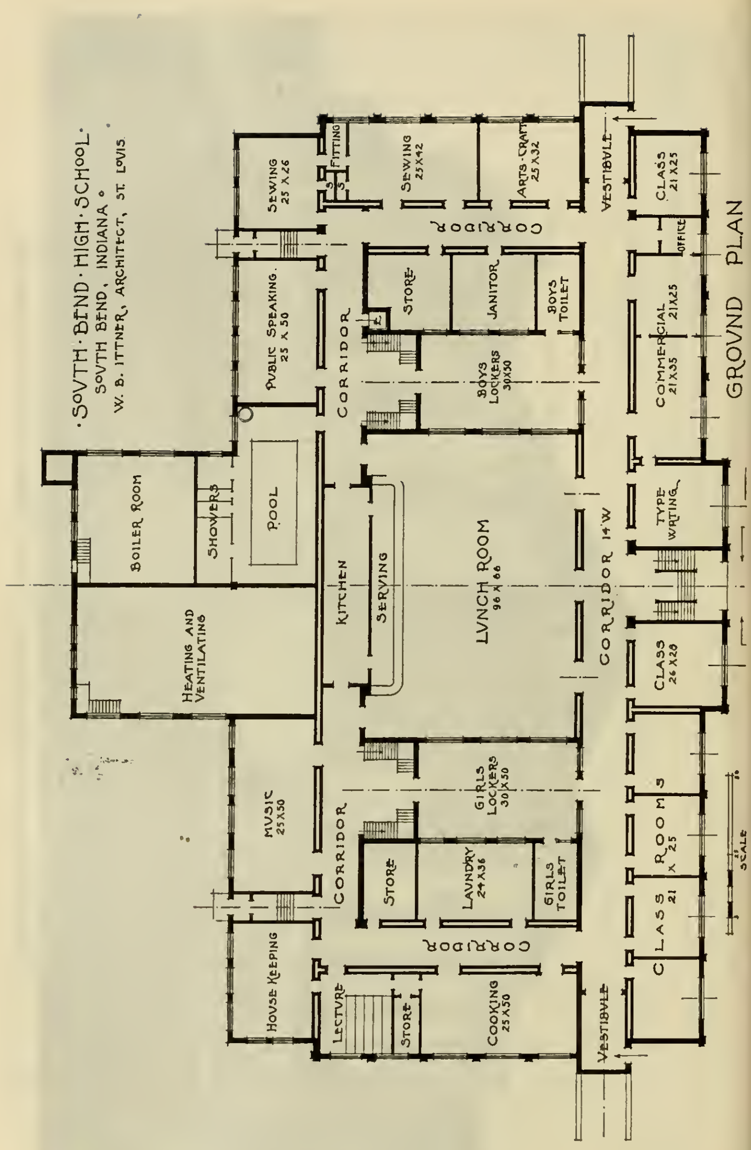


·SECOND·FLOOR·SKETCH·PLAN·NICHOLAS·SENN·HIGH·SCHOOL·
·A.F. HUSSANDER ·ARCHITECT·

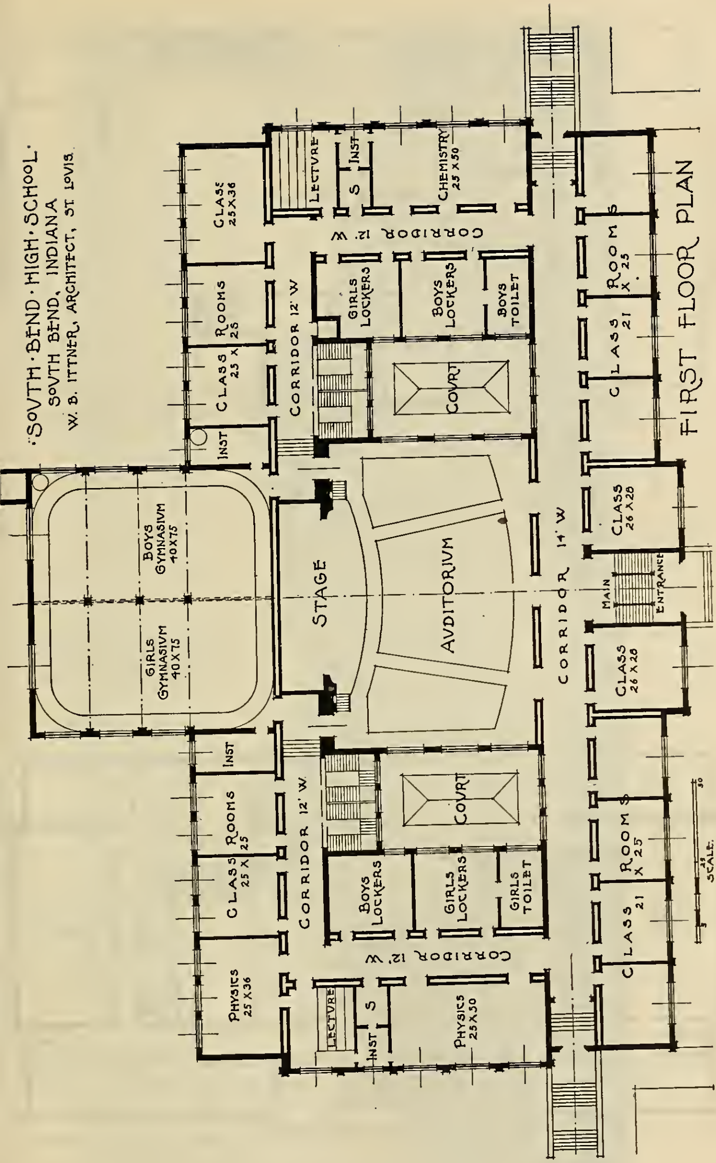


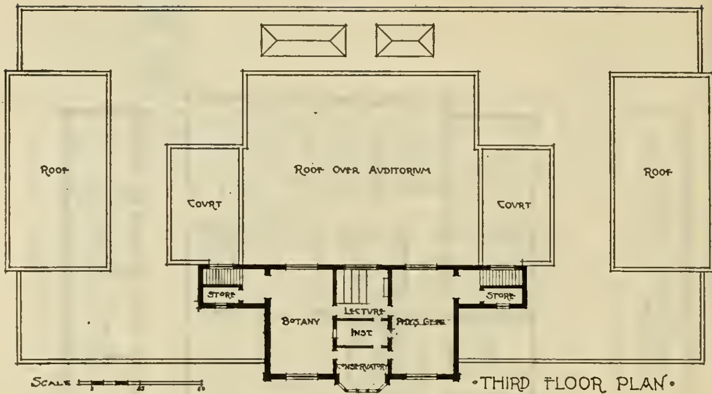
·THIRD·FLOOR·SKETCH·PLAN·NICHOLAS·SENN·HIGH·SCHOOL·
·A.F. HUSSANDER· ARCHITECT·

High School at South Bend, Indiana. Wm. B. Ittner, Architect, St. Louis, Mo.



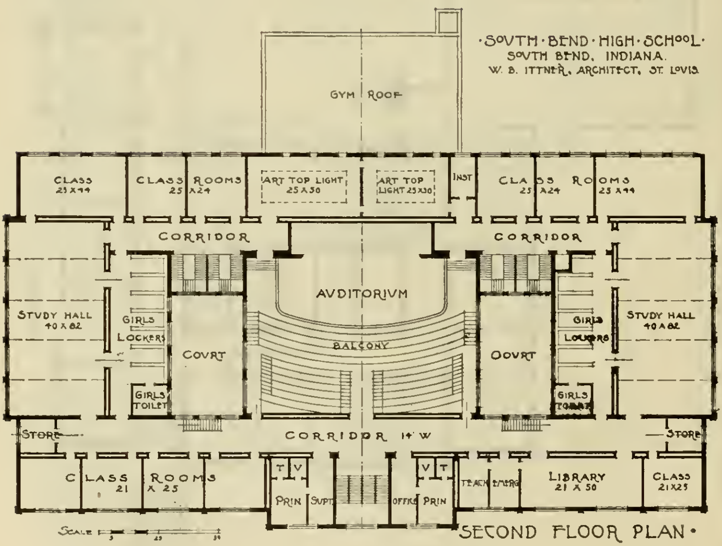
·SOUTH·BEND·HIGH·SCHOOL·
SOUTH BEND, INDIANA
W. B. ITTNER, ARCHITECT, ST. LOUIS
GROUND PLAN
SEWING 25 X 26
FITTING
SEWING 25X42
ARTS-CRAFT 25 X 32
VESTIBULE
CLASS 21 X 25
OFFICE
COMMERCIAL 21X25
COMMERCIAL 21 X 35
CORRIDOR
STORE
JANITOR
BOYS TOILET
PUBLIC SPEAKING 25 X 50
BOYS LOCKERS 30X50
BOILER ROOM
SHOWERS
POOL
TYPE WRITING
KITCHEN
SERVING
LUNCH ROOM 96 X 66
CORRIDOR 14'W
HEATING AND VENTILATING
CLASS 26 X 28
GIRLS LOCKERS 30 X 50
MUSIC 25X50
STORE
LAUNDRY 24 X 36
GIRLS TOILET
CLASS ROOMS 21 X 25
SCALE
HOUSE KEEPING
LECTURE
STORE
COOKING 25X50


SOUTH·BEND·HIGH·SCHOOL·
SOUTH BEND, INDIANA
W. B. ITTNER, ARCHITECT, ST LOUIS
CLASS 25 X 36
LECTURE
INST
S
CHEMISTRY 25 X 50
CORRIDOR 12' W
CLASS ROOMS 25 X 25
INST
CORRIDOR 12' W
GIRLS LOCKERS
BOYS LOCKERS
BOYS TOILET
COURT
CLASS ROOM 21 X 25
FIRST FLOOR PLAN
BOYS GYMNASIUM 40 X 75
GIRLS GYMNASIUM 40 X 75
STAGE
AUDITORIUM
CORRIDOR 14' W
CLASS 26 X 28
MAIN ENTRANCE
CLASS 26 X 28
INST
CLASS ROOMS 25 X 25
CORRIDOR 12' W
COURT
BOYS LOCKERS
GIRLS LOCKERS
GIRLS TOILET
CLASS ROOM 21 X 25
SCALE
CORRIDOR 12' W
PHYSICS 25 X 36
LECTURE
S
INST
PHYSICS 25 X 50

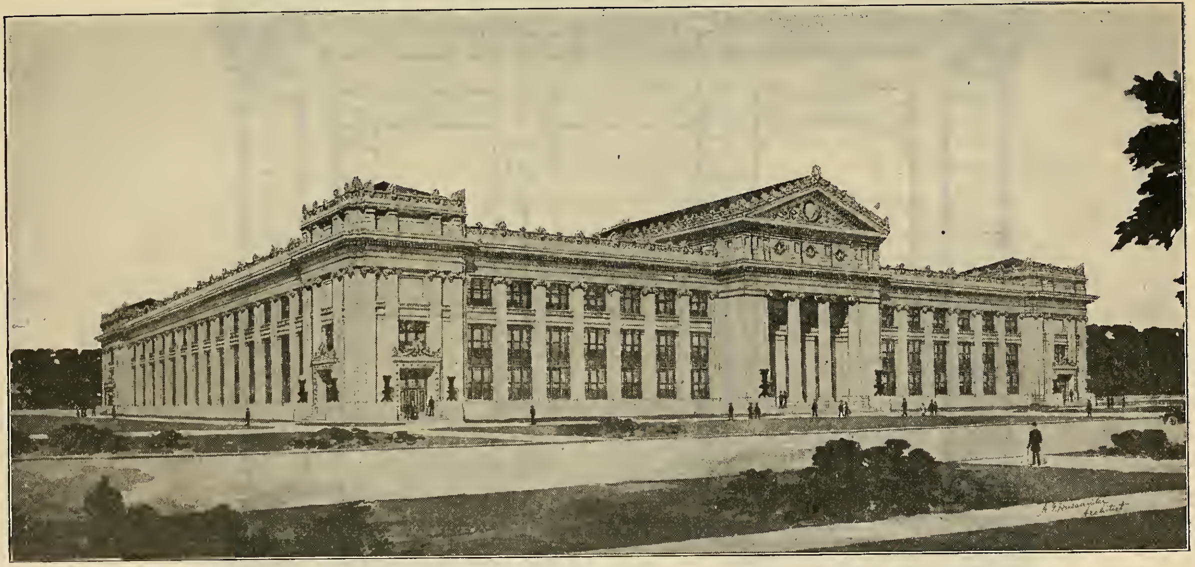


•THIRD FLOOR PLAN•

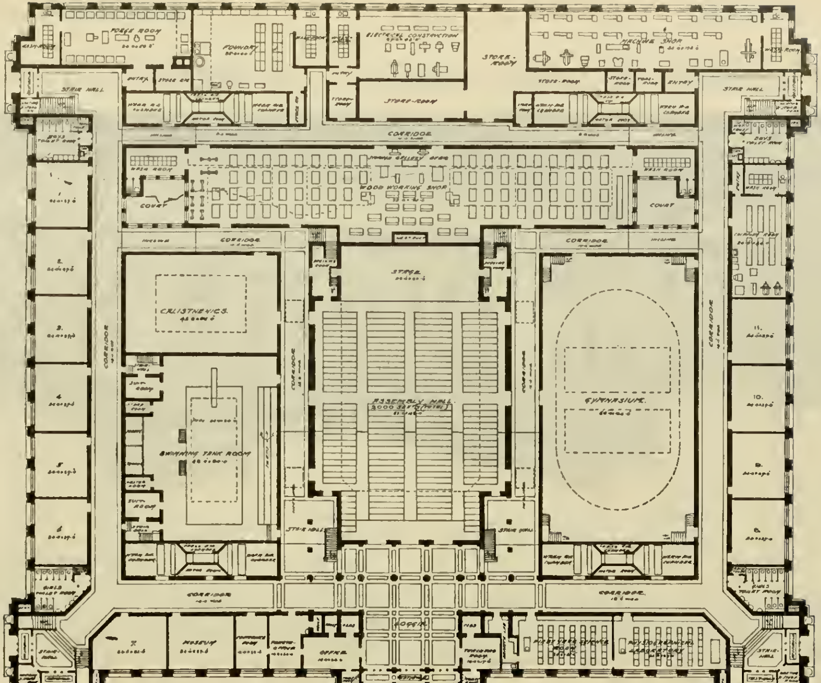
•SOUTH•BEND•HIGH•SCHOOL•
SOUTH BEND, INDIANA.
W. B. ITTNER, ARCHITECT, ST. LOUIS



SECOND FLOOR PLAN•

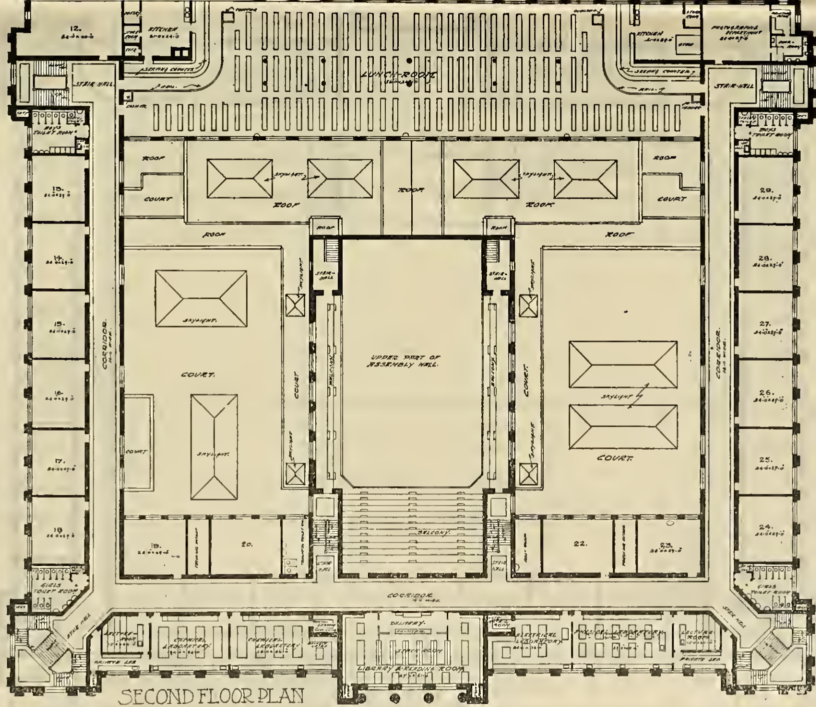


Carter H. Harrison High School, Chicago, Ill. A. F. Husander, Architect. Cost $950,000=15c. per cu. ft.

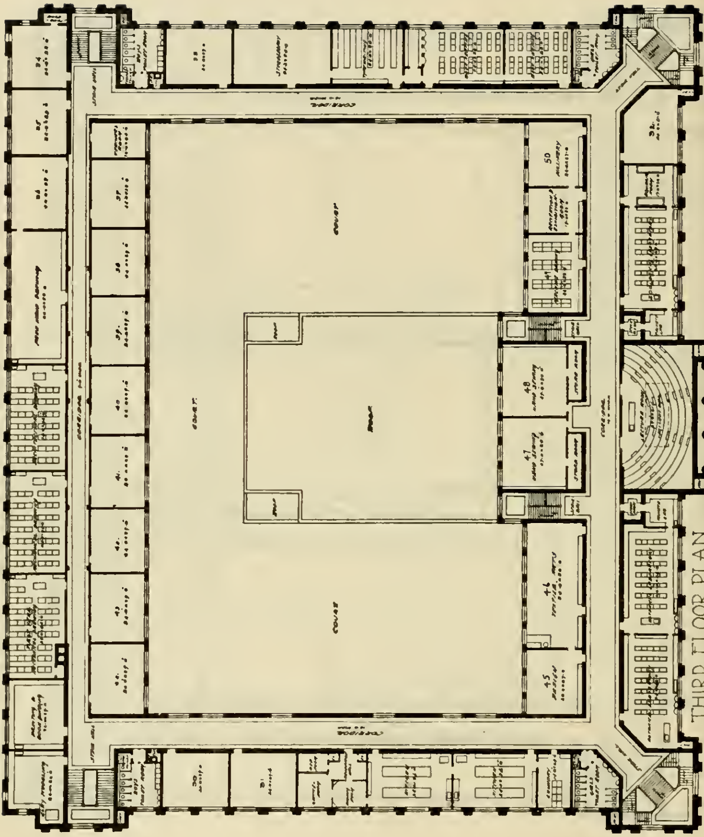


FIRST FLOOR PLAN

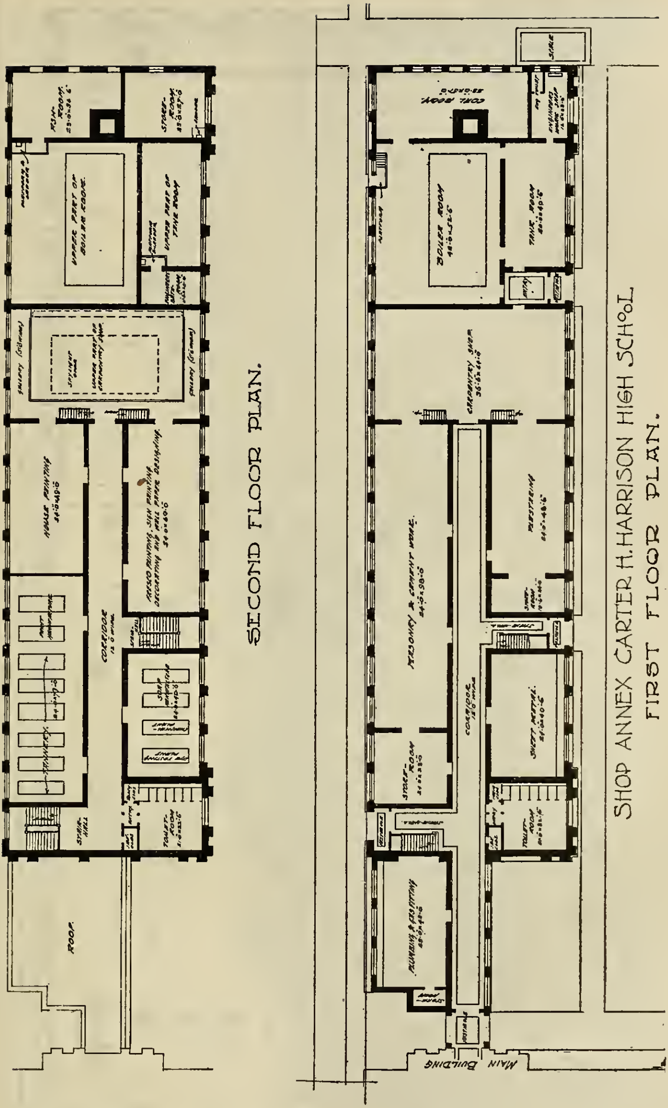
Carter H. Harrison High School, Chicago, Ill. A. F. Husander, Architect.



Carter H. Harrison High School, Chicago, Ill. A. F. Husander, Architect.

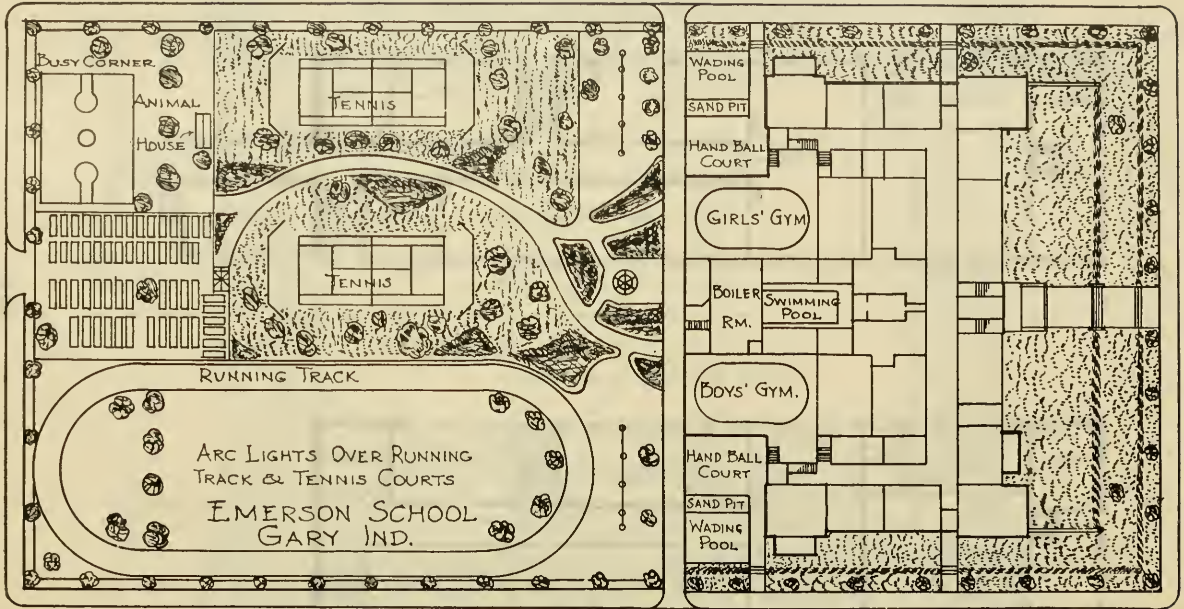


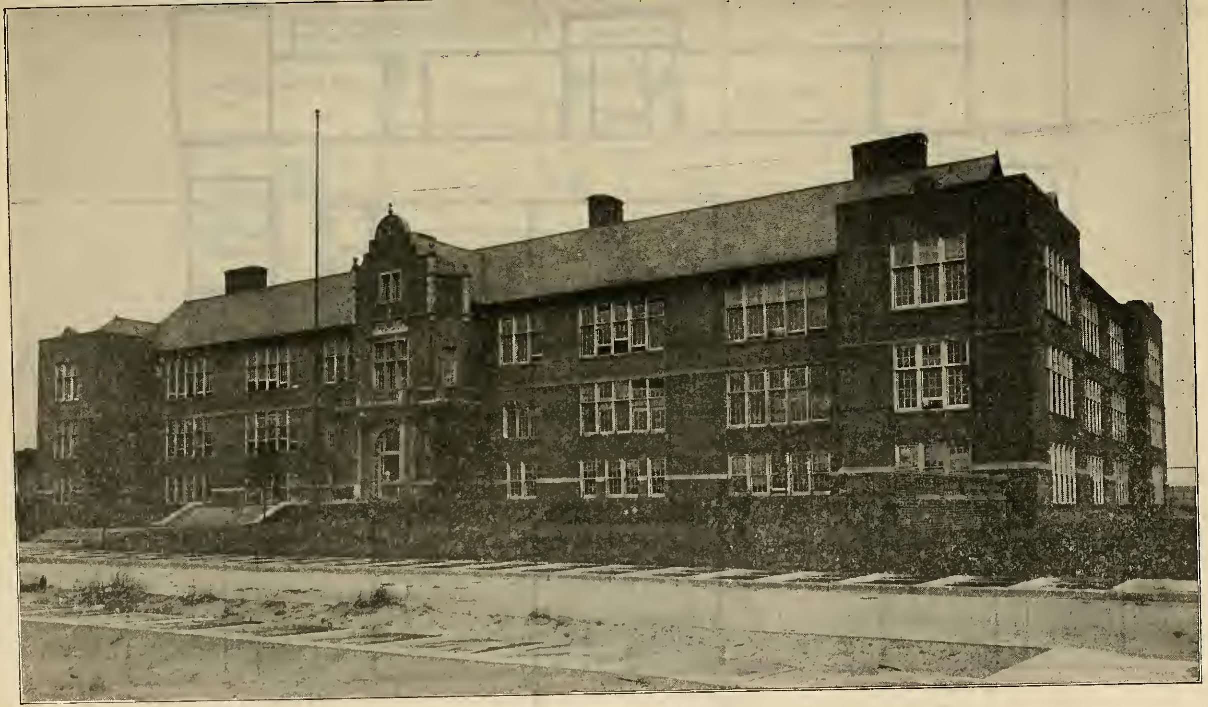
Carter H. Harrison High School, Chicago, Ill. A. F. Husander, Architect.



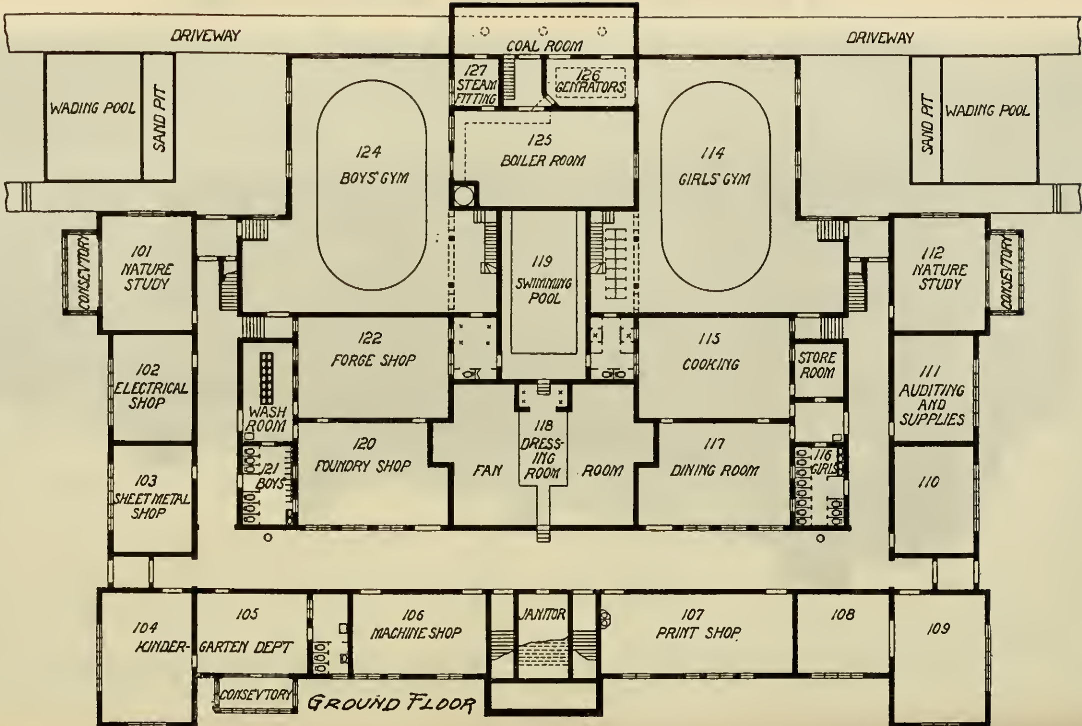
SECOND FLOOR PLAN.

SHOP ANNEX CARTER H. HARRISON HIGH SCHOOL
FIRST FLOOR PLAN.

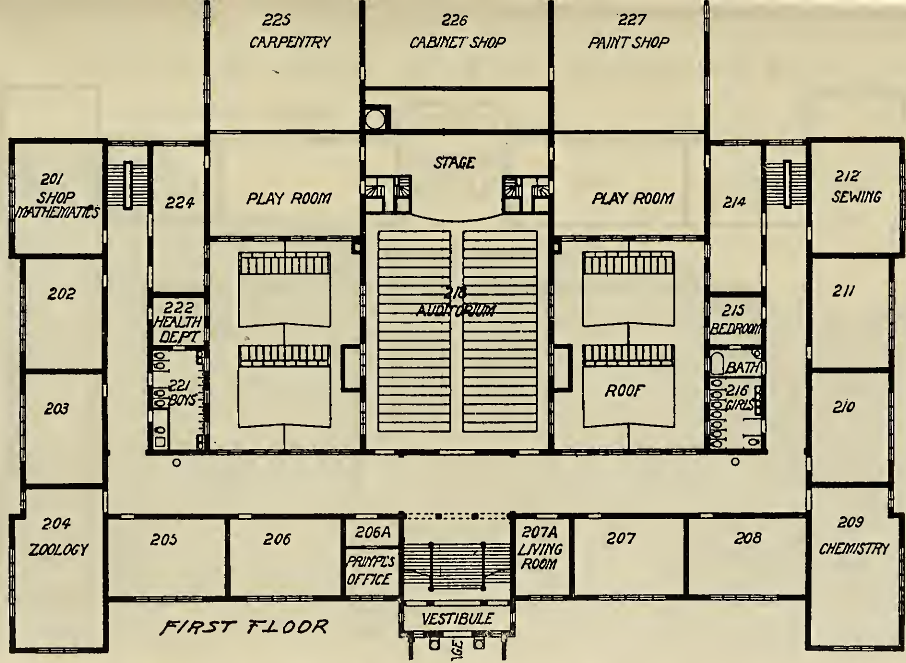

Busy Corner
Animal
House
Tennis
Tennis
Running Track
Arc Lights Over Running
Track & Tennis Courts
Emerson School
Gary Ind.
Wading Pool
Sand Pit
Hand Ball Court
Girls' Gym
Boiler Rm.
Swimming Pool
Boys' Gym.
Hand Ball Court
Sand Pit
Wading Pool



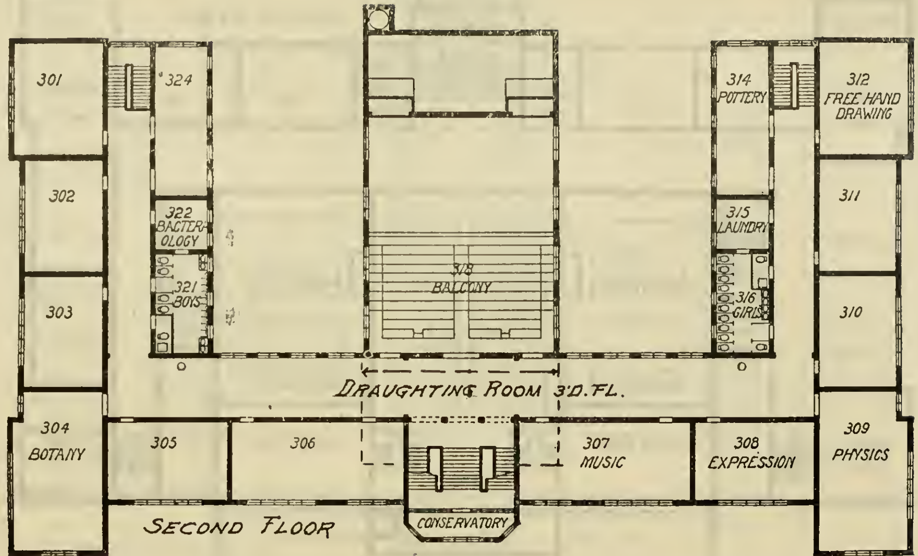
Emmerson School, Gary, Ind. Wm. B. Ittner, Architect, St. Louis, Mo.



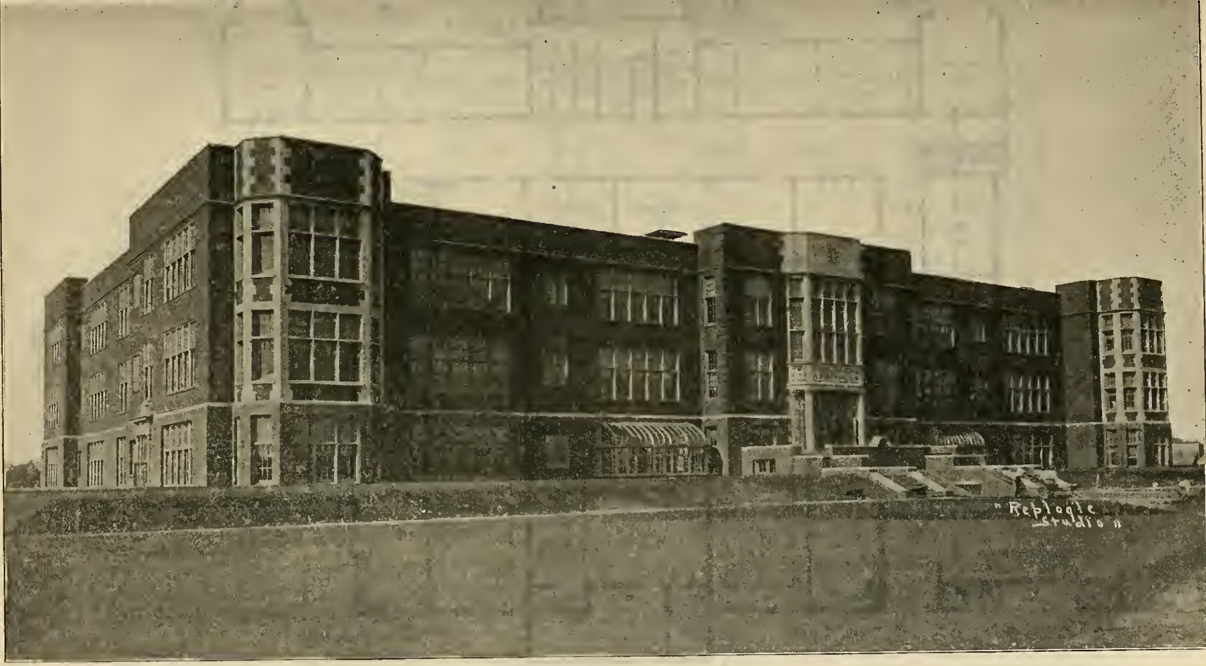
Emerson School, Gary, Ind. Wm. B. Ittner, Architect, St. Louis, Mo.



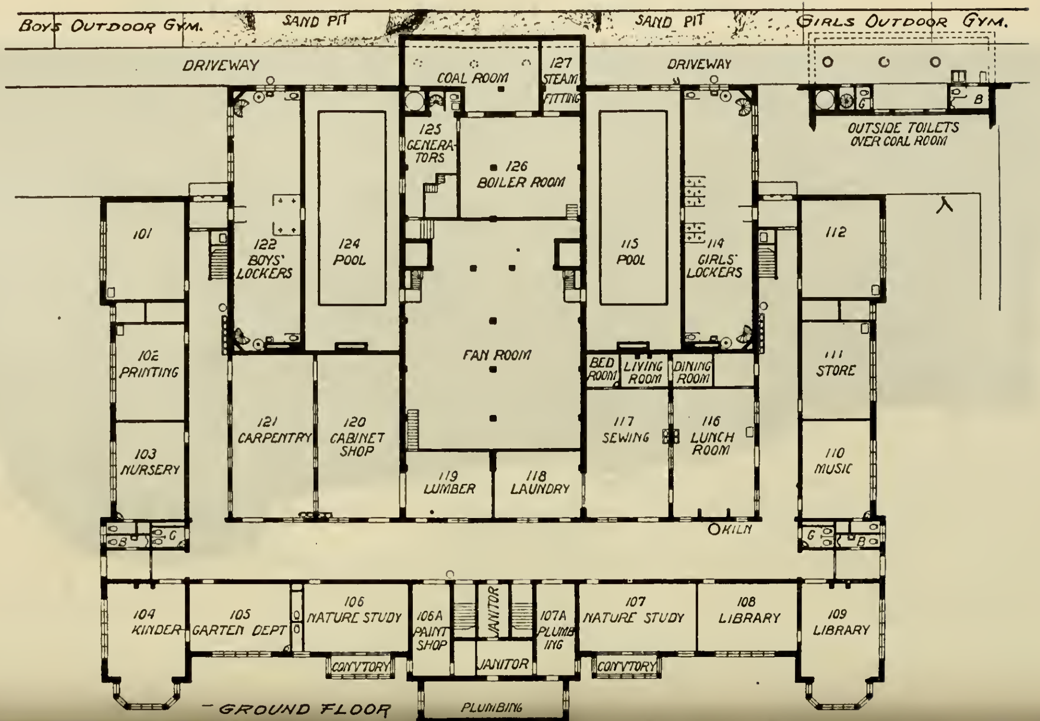
Emerson School, Gary, Ind. Wm. B. Ittner, Architect, St. Louis, Mo.



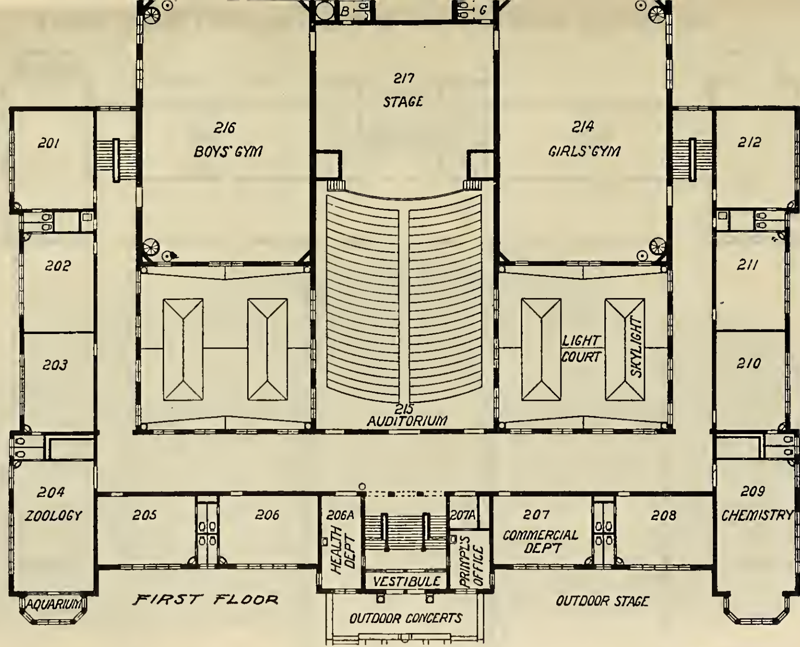
Emerson School, Gary, Ind. Wm. B. Ittner, Architect, St. Louis, Mo.



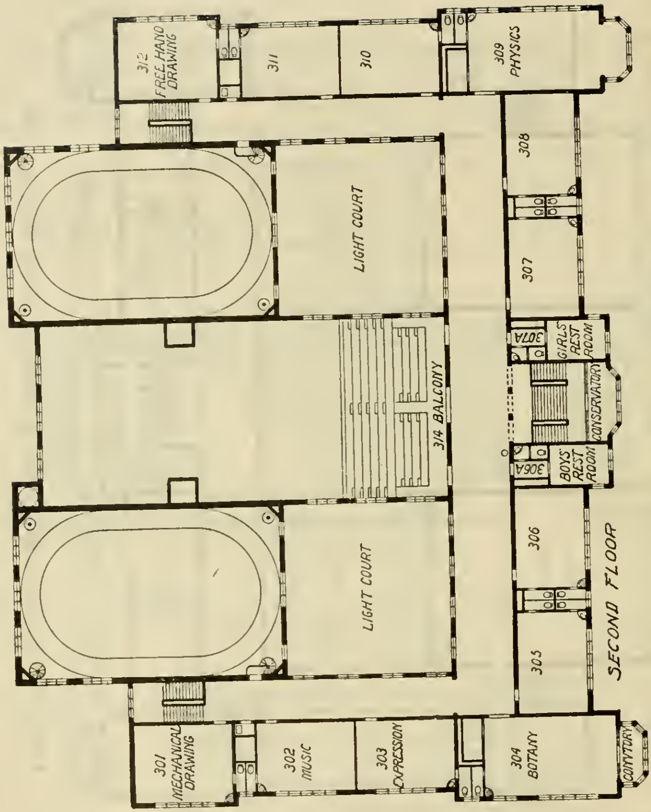
Froebel School, Gary, Ind. Wm. B. Ittner, Architect, St. Louis, Mo.



Froebel School, Gary, Ind.—Wm. B. Ittner, Architect, St. Louis, Mo.

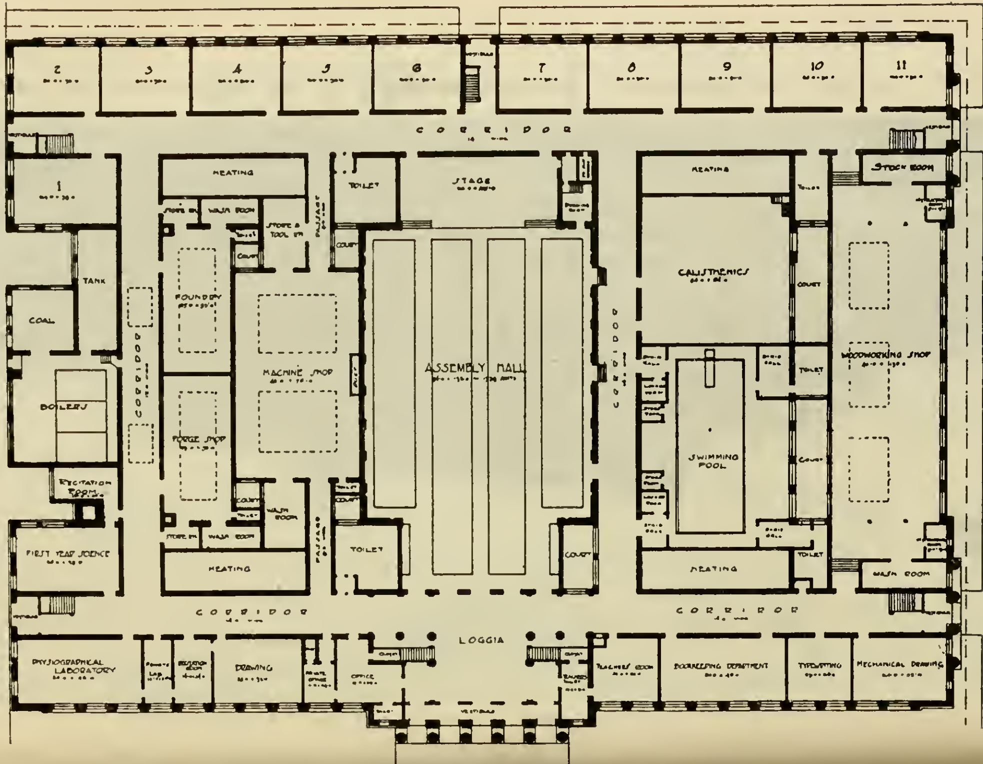


Froebel School, Gary, Ind. Wm. B. Ittner, Architect, St. Louis, Mo.

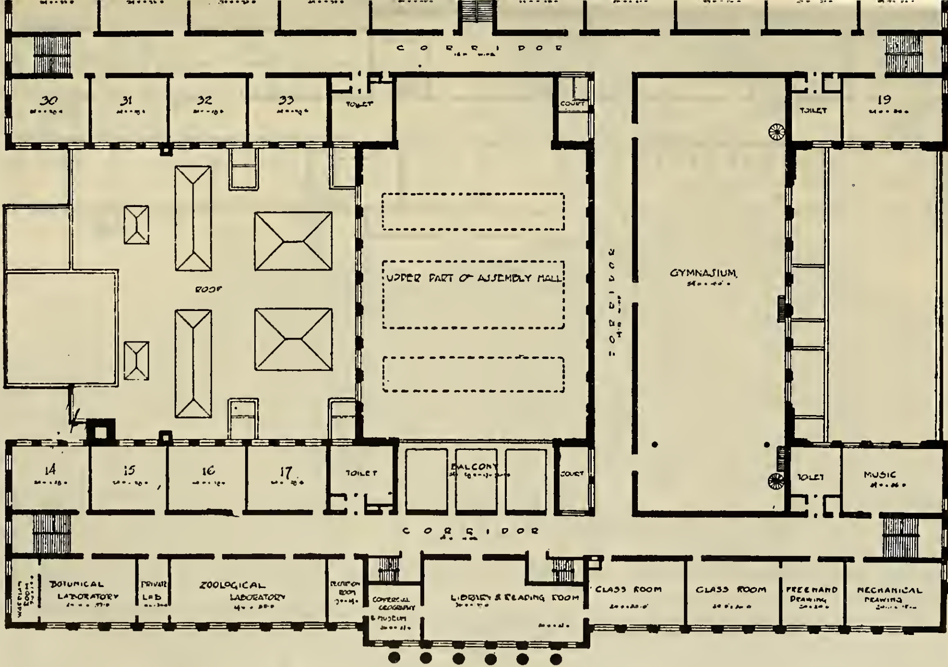


Froebel School, Gary, Ind. Wm. B. Ittner, Architect, St. Louis, Mo.

Hyde Park High School, Chicago, Ill., A. F. Husander, Architect. Cost $700,000. Equipped=15.1c. per cu. ft.

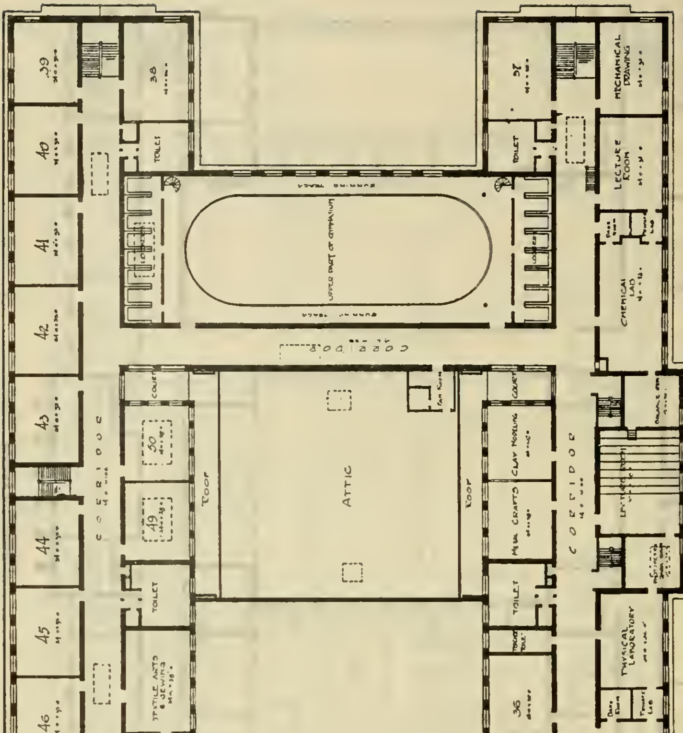


First Floor Plan, Hyde Park High School, Chicago, Ill. A. F. Husander, Architect.



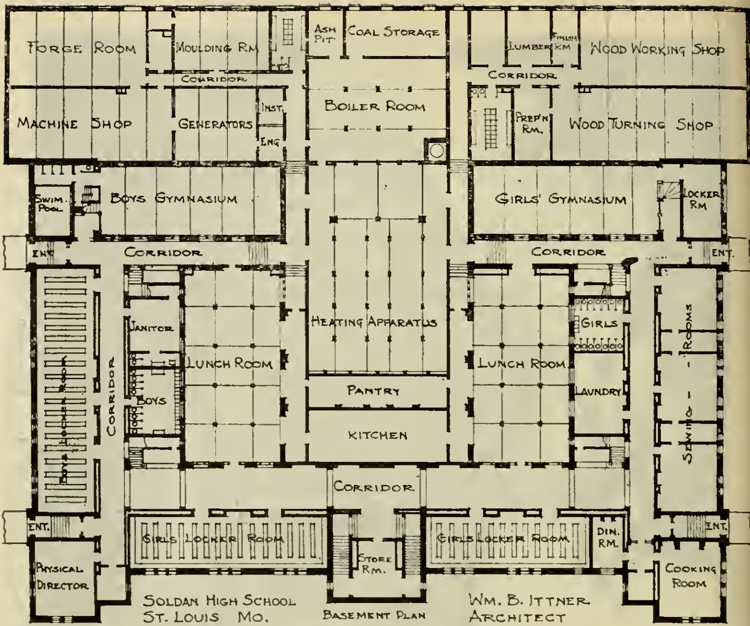
SECOND FLOOR PLAN.

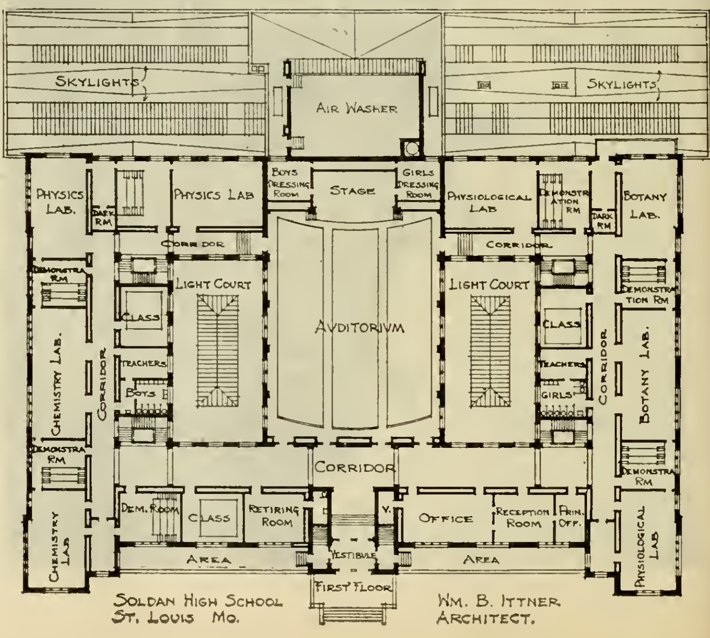
Hyde Park High School, Chicago, Ill. A. F. Husander, Architect.

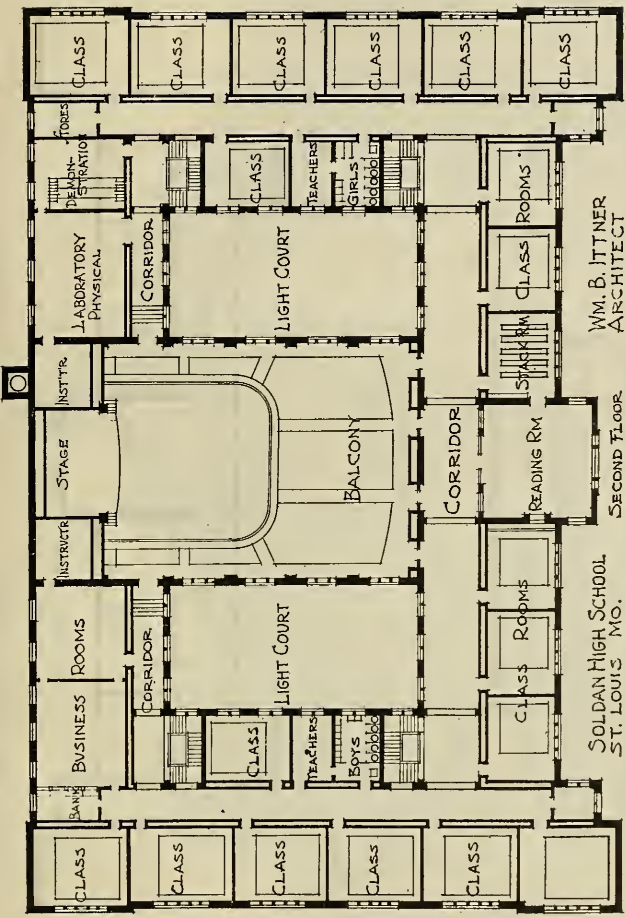


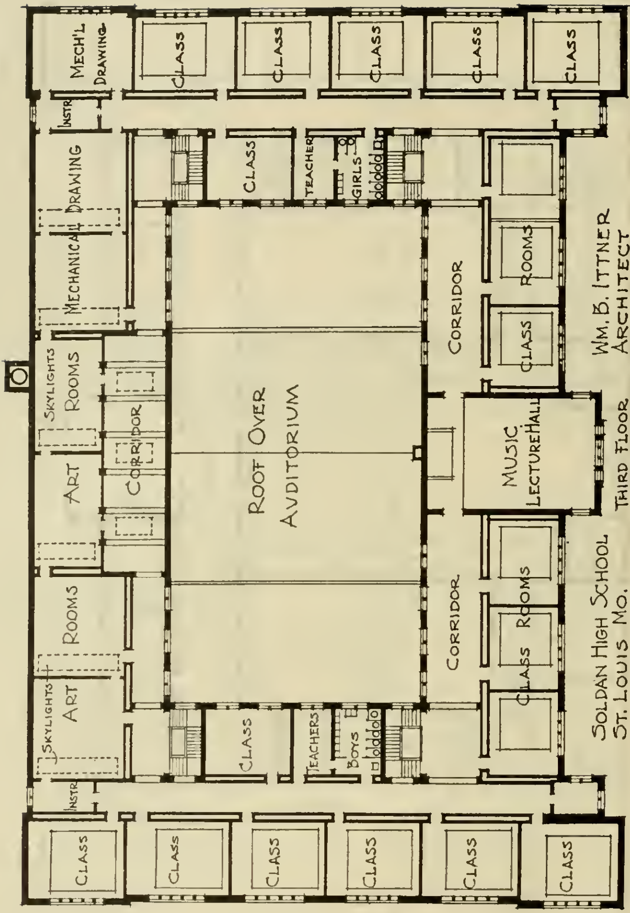
Third Floor Plan, Hyde Park High School, Chicago, Ill. A. F. Husander, Architect.

Soldan High School, St. Louis, Mo. Wm. B. Ittner, Architect. Cost $636,000=18.5c per cu. ft.

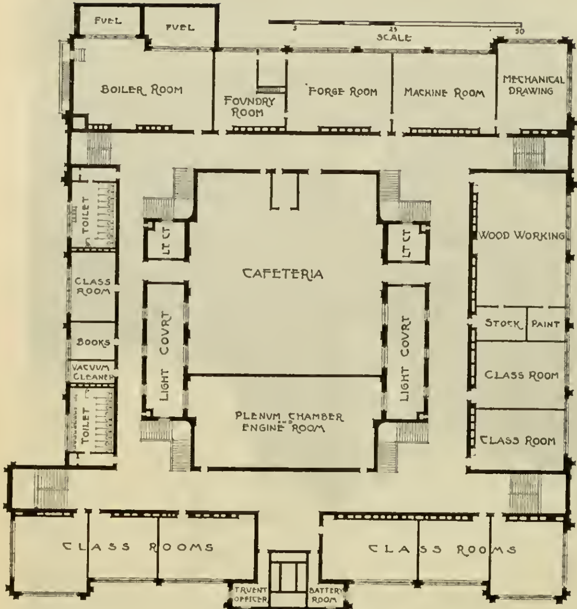

Forge Room
Moulding Rm
Corridor
Machine Shop
Generators
Inst.
Eng
Ash Pit
Coal Storage
Boiler Room
Lumber Rm
Finish Rm
Wood Working Shop
Corridor
Prep'n Rm.
Wood Turning Shop
Swim. Pool
Boys Gymnasium
Girls' Gymnasium
Locker Rm
Ent.
Corridor
Corridor
Ent.
Janitor
Lunch Room
Heating Apparatus
Lunch Room
Girls
Sewing Rooms
Boys
Boys Locker Room
Corridor
Pantry
Kitchen
Laundry
Corridor
Ent.
Girls Locker Room
Store Rm.
Girls Locker Room
Din. Rm.
Ent.
Physical Director
Cooking Room
Soldan High School
St. Louis Mo.
Basement Plan
Wm. B. Ittner
Architect


Skylights
Air Washer
Skylights
Physics Lab.
Dark Rm
Physics Lab
Boys Dressing Room
Stage
Girls Dressing Room
Physiological Lab
Demonstration Rm
Dark Rm
Botany Lab.
Corridor
Corridor
Demonstra Rm
Light Court
Class
Auditorium
Light Court
Class
Demonstration Rm
Chemistry Lab.
Corridor
Teachers
Boys
Teachers
Girls
Corridor
Botany Lab.
Demonstra Rm
Corridor
Demonstra Rm
Dem. Room
Class
Retiring Room
V.
Office
Reception Room
Prin. Off.
Chemistry Lab
Area
Vestibule
Area
Physiological Lab
First Floor
Soldan High School
St. Louis Mo.
Wm. B. Ittner
Architect.

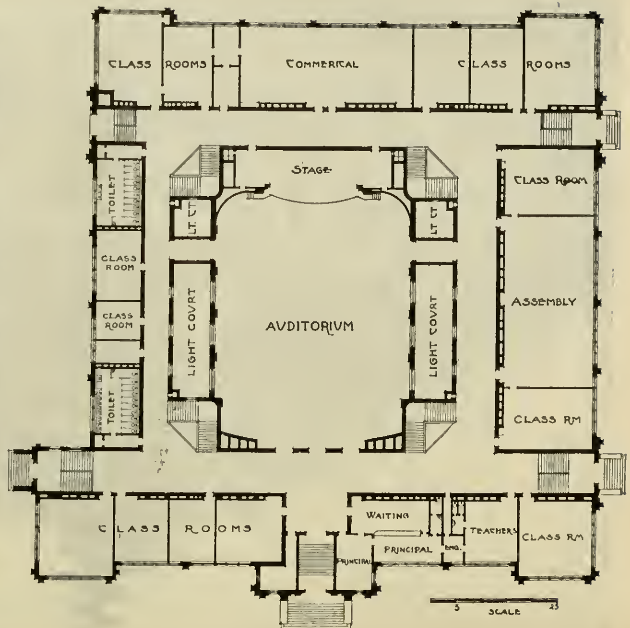

SOLDAN HIGH SCHOOL
ST. LOUIS MO.
SECOND FLOOR
WM. B. ITTNER
ARCHITECT
CLASS
CLASS
CLASS
CLASS
CLASS
CLASS
STORES
DEMON-
STRATION
LABORATORY
PHYSICAL
CORRIDOR
LIGHT COURT
CLASS
TEACHERS
GIRLS
ROOMS
CLASS
STACK RM
INST'T'R
STAGE
INSTRUCTR
BALCONY
CORRIDOR
READING RM
ROOMS
CLASS
BUSINESS
CORRIDOR
LIGHT COURT
CLASS
TEACHERS
BOYS
BANK
CLASS
CLASS
CLASS
CLASS
CLASS


Mech'l Drawing
Instr
Class
Mechanical Drawing
Class
Teacher
Girls
Corridor
Class Rooms
Class
Skylights
Rooms
Art
Corridor
Roof Over Auditorium
Music Lecture Hall
Rooms
Art
Skylights
Teachers
Boys
Class Rooms
Soldan High School
St. Louis Mo.
Third Floor
Wm. B. Ittner
Architect

Lewis & Clark High School, Spokane, Wash. L. L. Rand, Architect. Fireproof. Cost 21.75c per cu. ft.

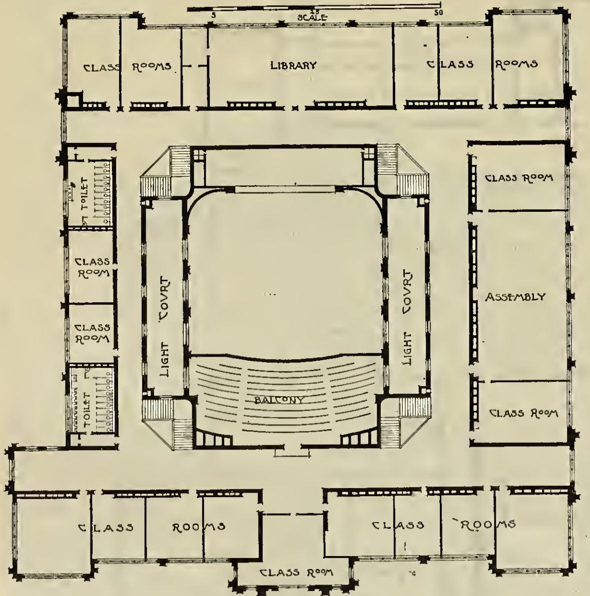


BASEMENT PLAN

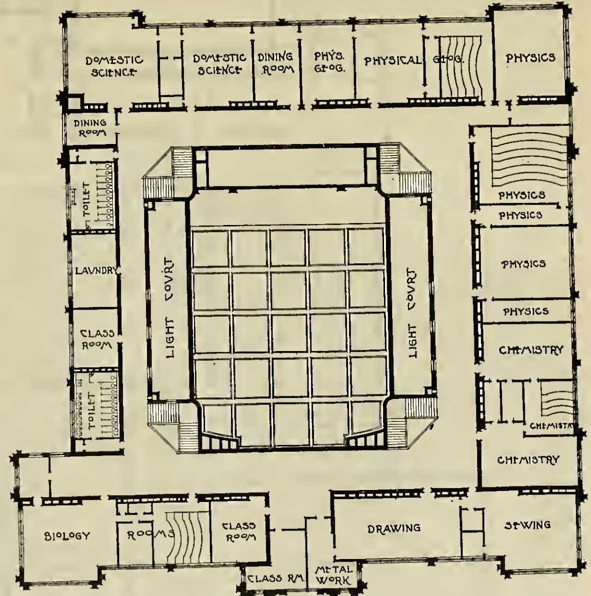


FIRST FLOOR PLAN

Lewis & Clark High School, Spokane, Wash. L. L. Rand, Architect.

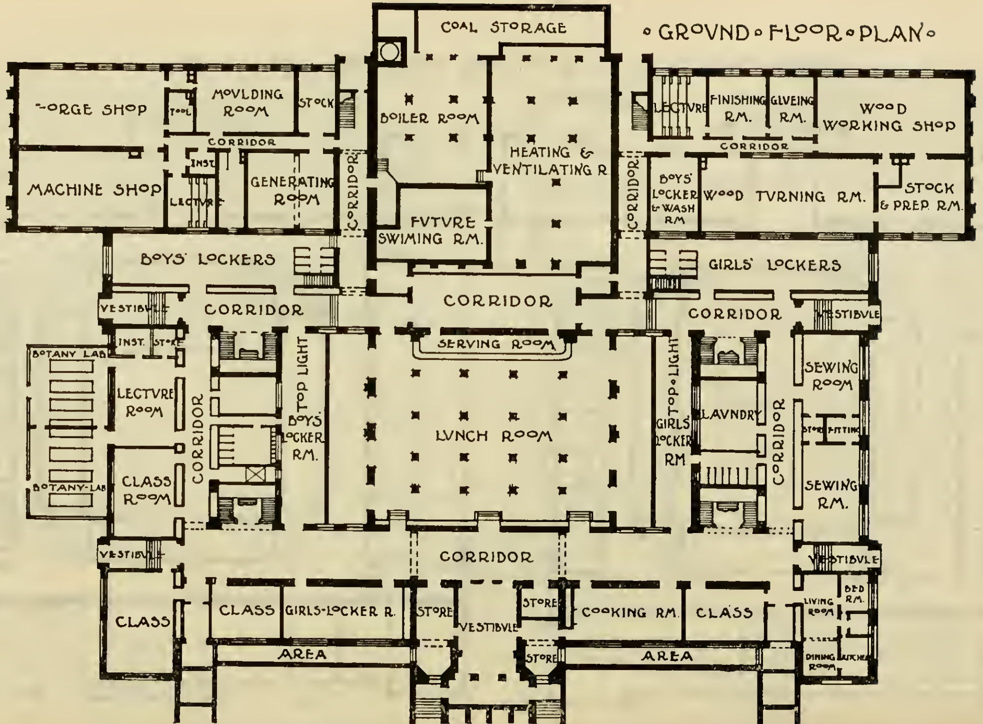


• SECOND • FLOOR • PLAN •

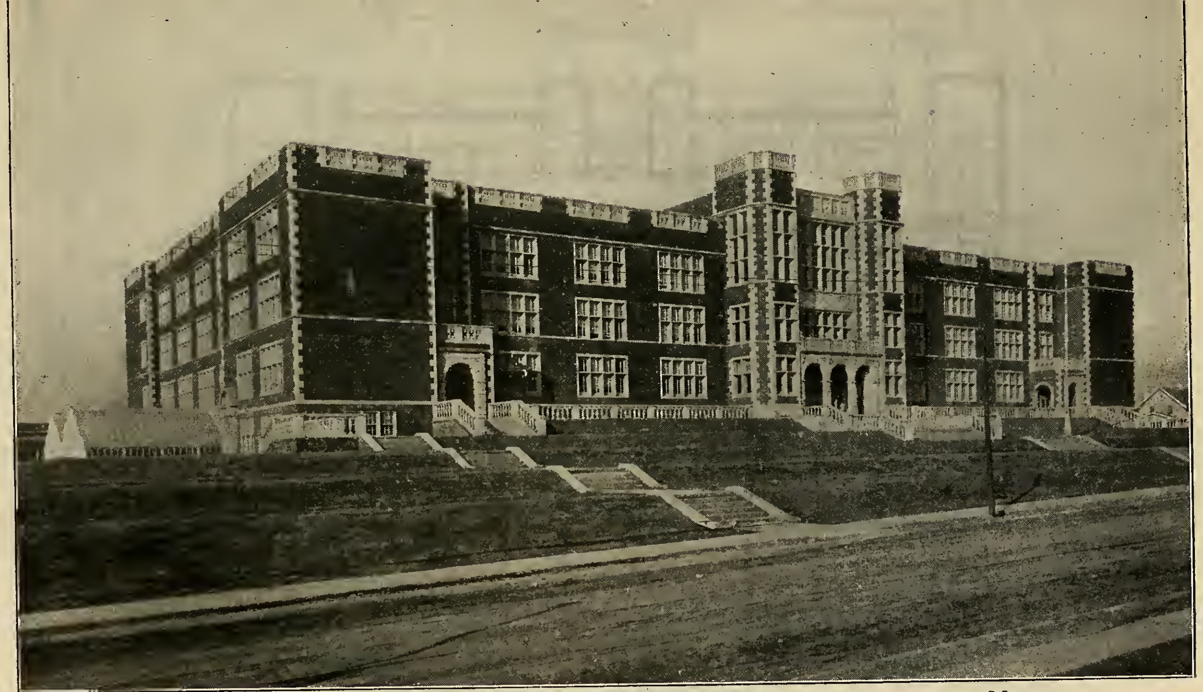


• THIRD • FLOOR • PLAN •

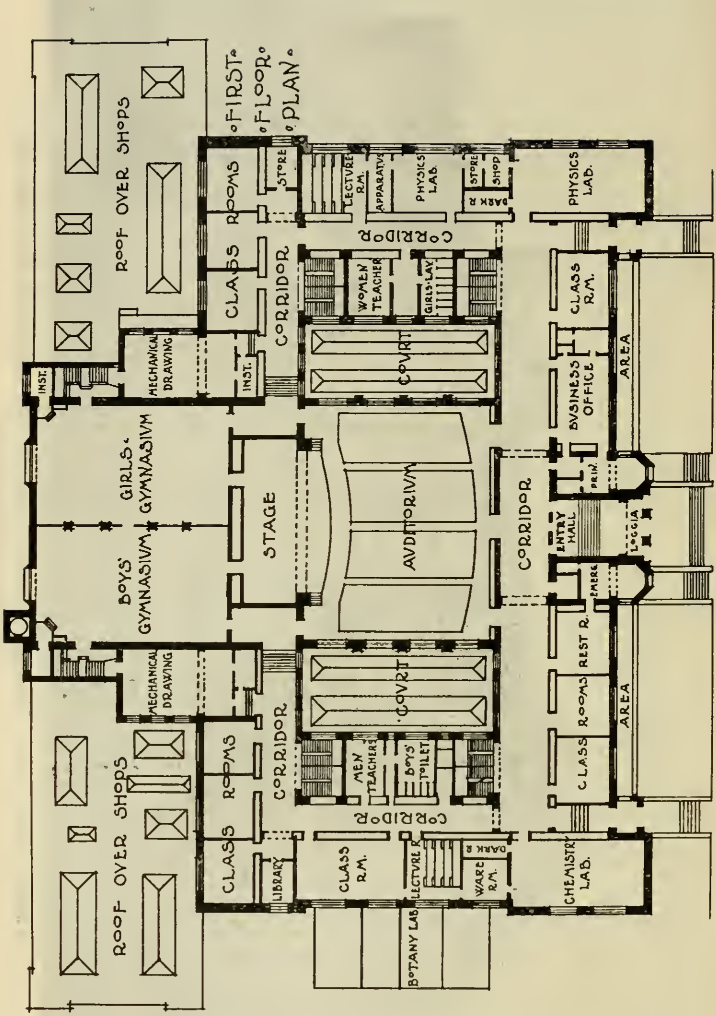
Lewis & Clark High School, Spokane, Wash. L. L. Rand, Architect.



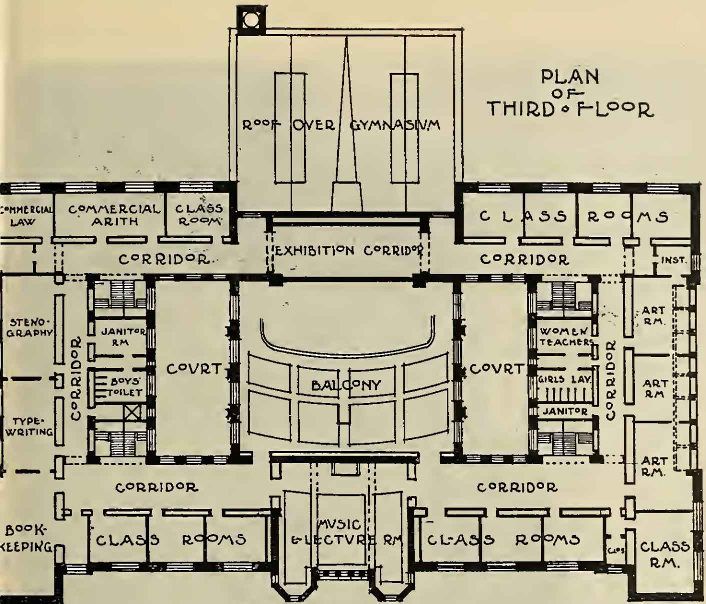
Central High School, Minneapolis, Minn., Wm. B. Ittner, Architect, St. Louis, Mo.

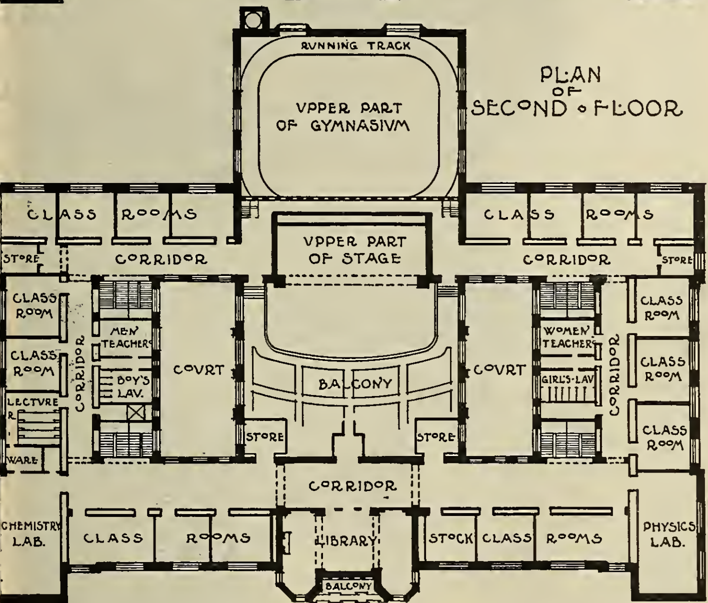


Central High School, Minneapolis, Minn., Wm. B. Ittner, Architect, St. Louis, Mo.



Central High School, Minneapolis, Minn. Wm. B. Ittner, Architect, St. Louis, Mo.

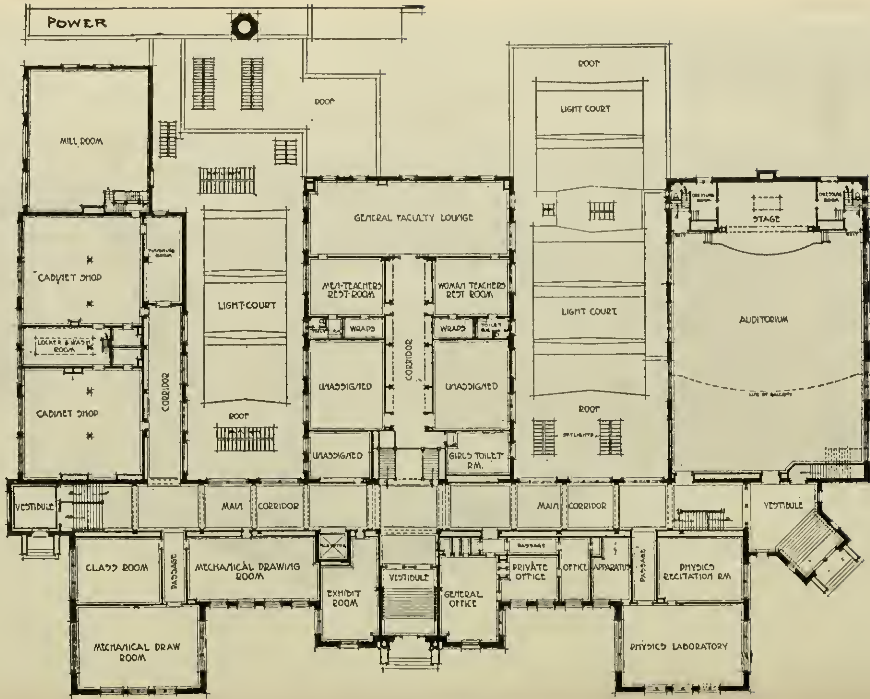




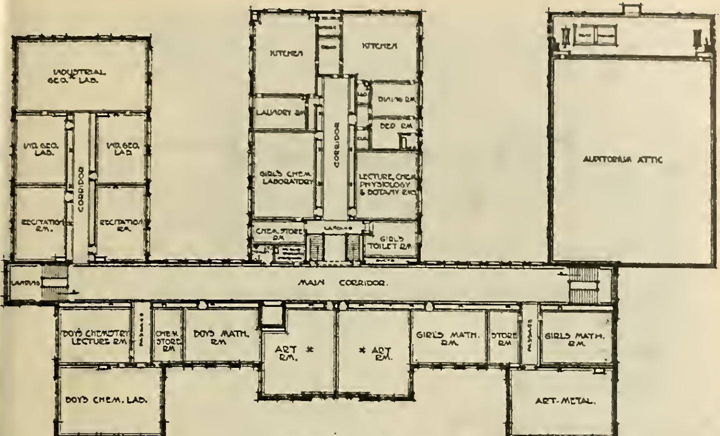
Central High School, Minneapolis, Minn. Wm. B. Ittner, Architect, St. Louis, Mo.

Central High School, Minneapolis, Minn., Wm. B. Ittner, Architect, St. Louis, Mo.

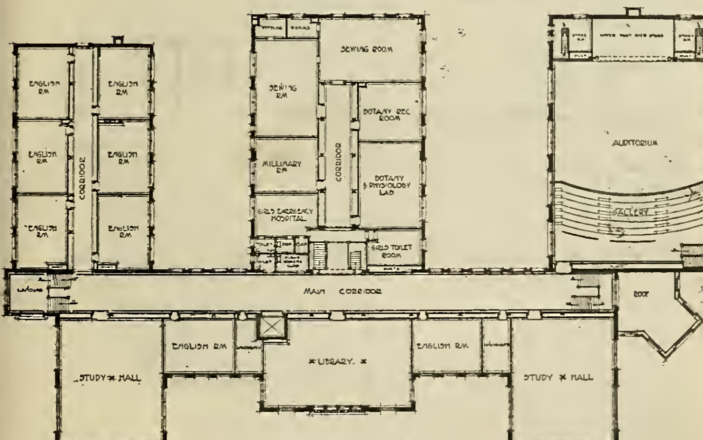
West Technical High School, Cleveland, Ohio. F. S. Barnum, Architect. Fireproof. Cost $700,000 equipped.



West Technical High School, Cleveland, Ohio. F. S. Barnum, Architect.

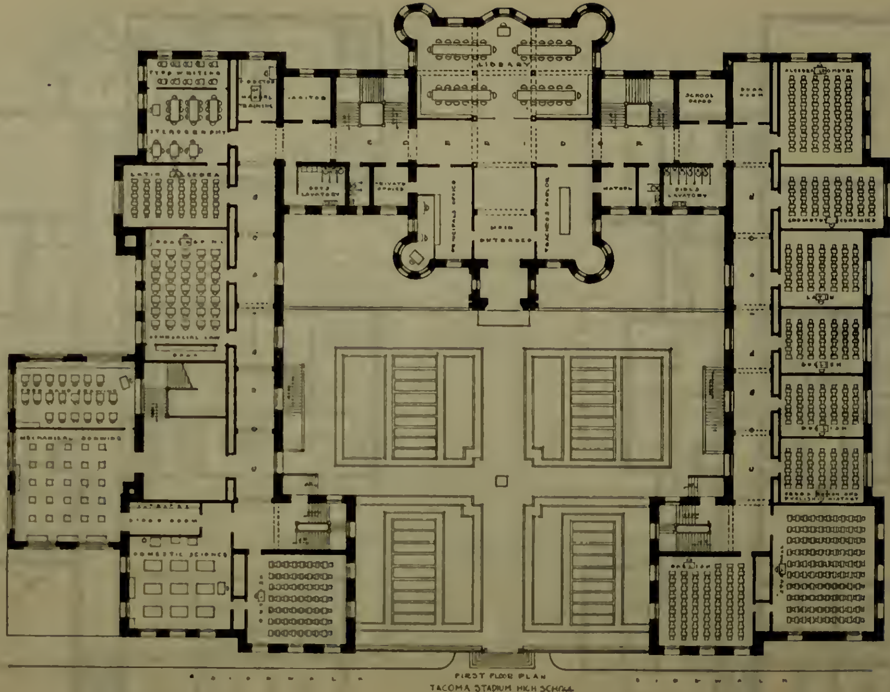


THIRD FLOOR PLAN.



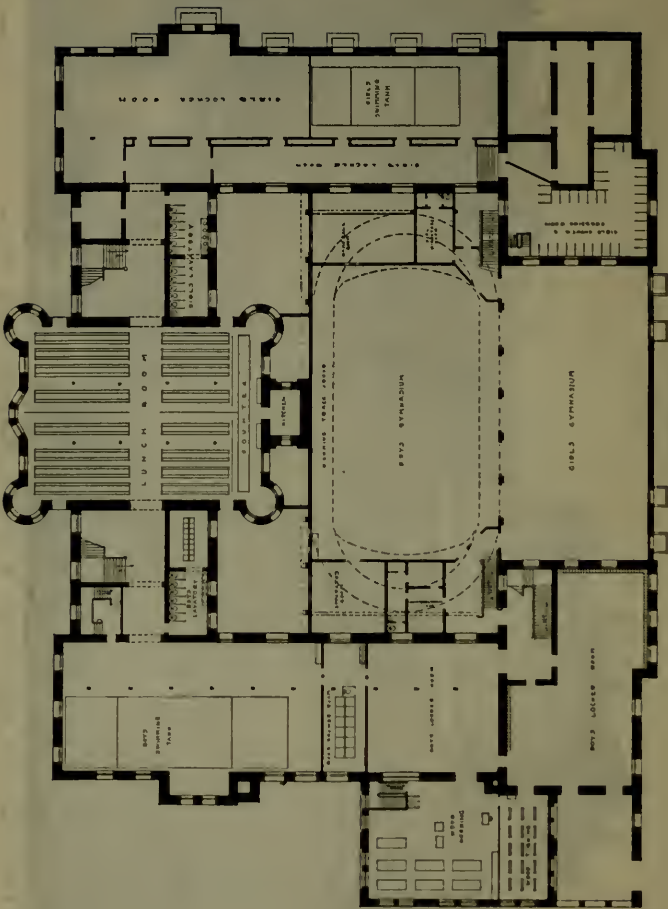
SECOND FLOOR PLAN.

West Technical High School, Cleveland, Ohio. F. S. Barnum, Architect.
Plans by Courtesy of The American School Board Journal.

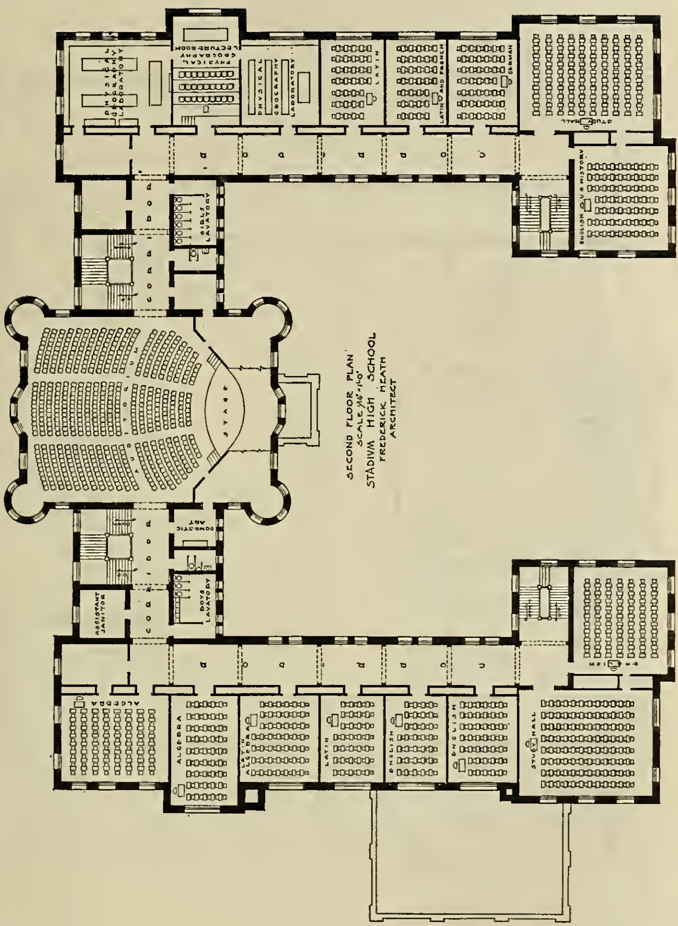


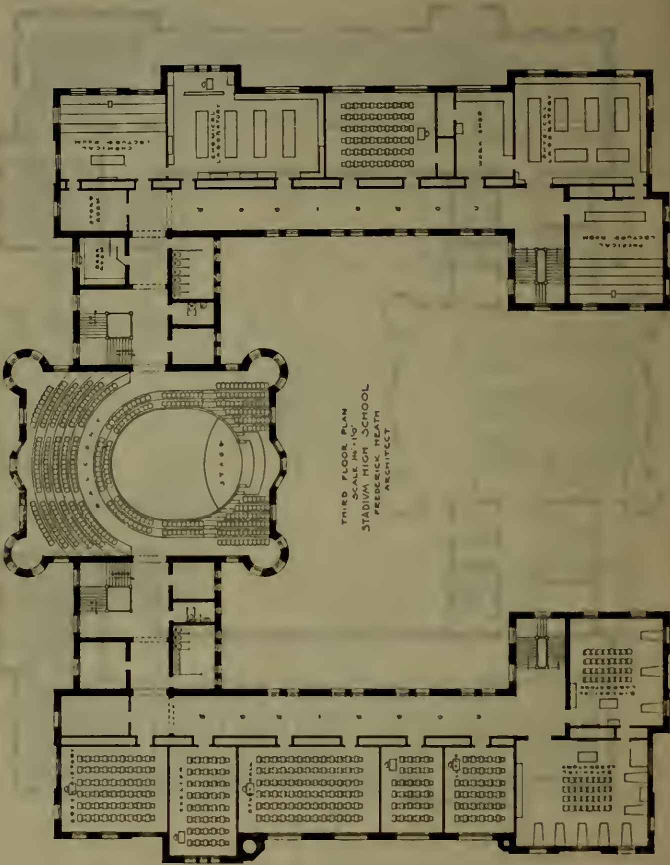
Stadium High School, Tacoma, Wash.   Frederick Heath, Architect

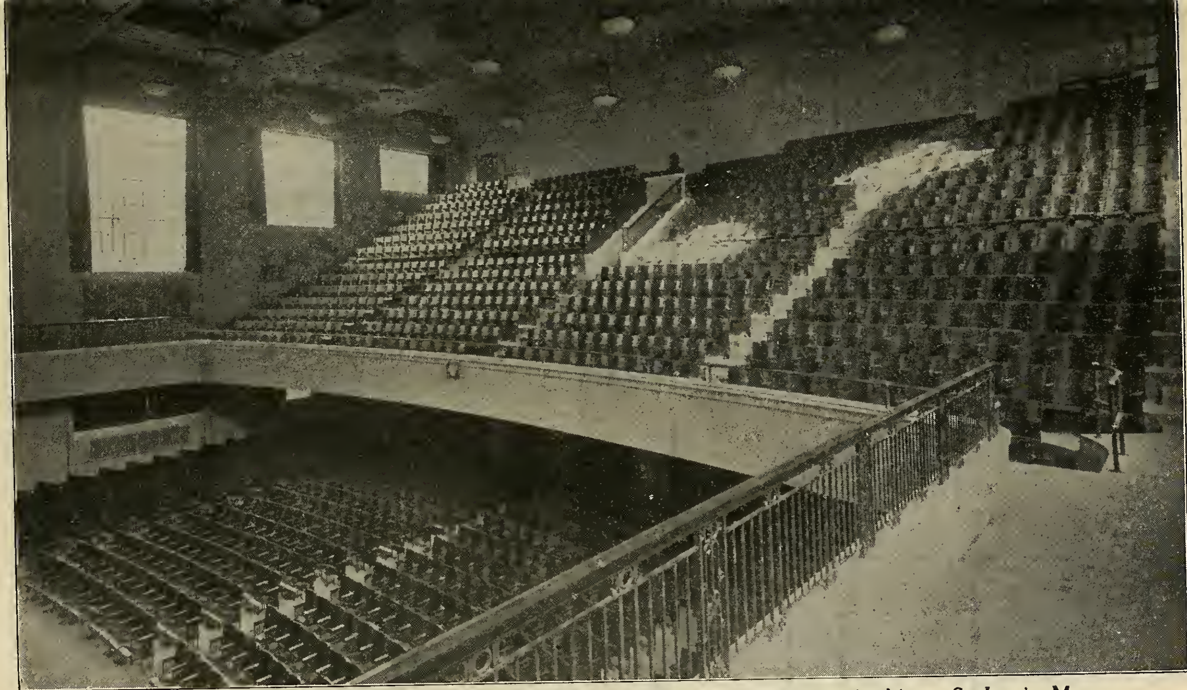
Stadium High School, and the Stadium, Tacoma, Washington. Frederick Heath, Architect. L. A. Nicholson, Engineer. Ex-President Roosevelt speaking to about 30,000 persons.



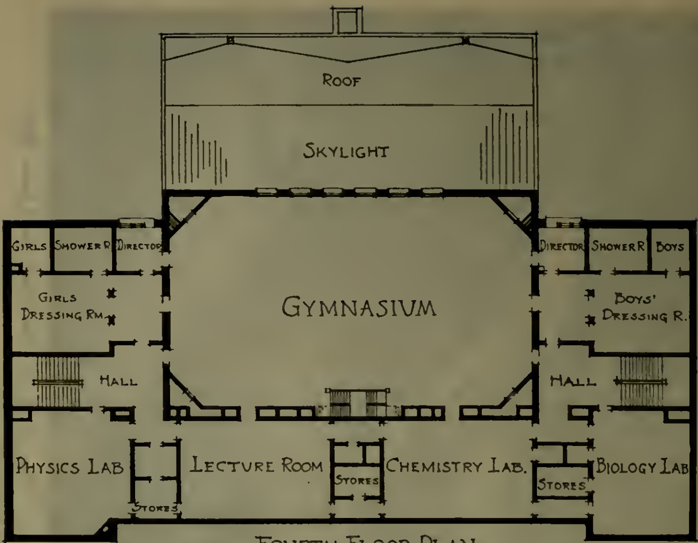
BASEMENT PLAN
TACOMA STADIUM HIGH SCHOOL
FREDERICK HEATH, ARCHITECT


SECOND FLOOR PLAN
SCALE 1/16"=1'0"
STADIVM HIGH SCHOOL
FREDERICK HEATH
ARCHITECT
PHYSICAL GEOGRAPHY LABORATORY
PHYSICAL GEOGRAPHY LECTURE ROOM
LATIN
LATIN AND FRENCH
GERMAN
STUDY HALL
ENGLISH U.S. HISTORY
GIRLS LAVATORY
CORRIDOR
AUDITORIUM
STAGE
DOMESTIC ART
BOYS LAVATORY
ASSISTANT JANITOR
ALGEBRA
LATIN ALGEBRA
ENGLISH


THIRD FLOOR PLAN
SCALE 1/16"=1'0"
STADIVM HIGH SCHOOL
FREDERICK HEATH
ARCHITECT
STAGE

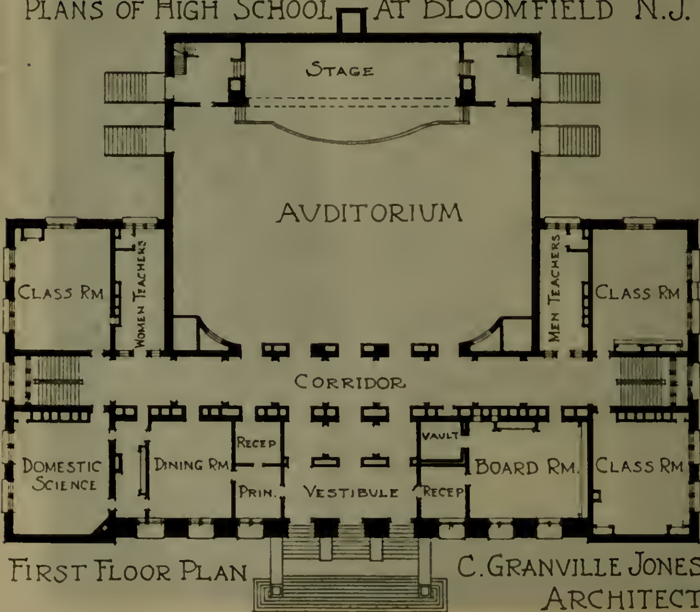


Auditorium in Central High School, Minneapolis, Minn. Wm. B. Ittner, Architect, St. Louis, Mo.
See Plans and Exterior on Pages 552—6.



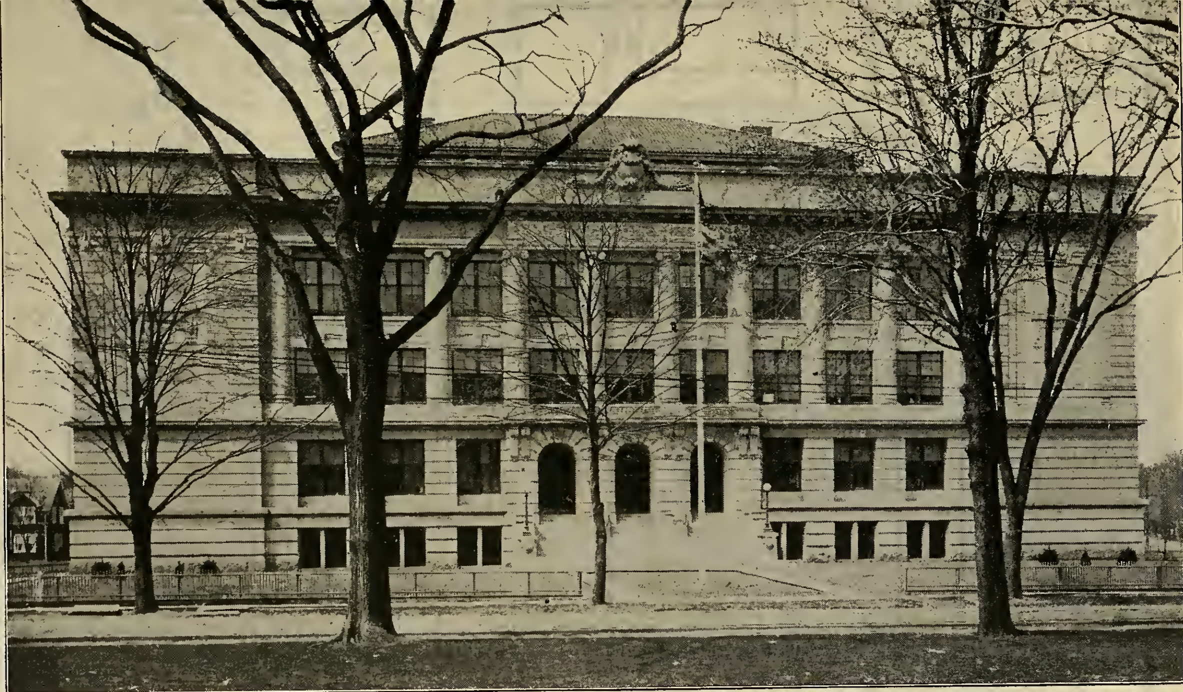
Fourth Floor Plan

Plans of High School at Bloomfield N.J.

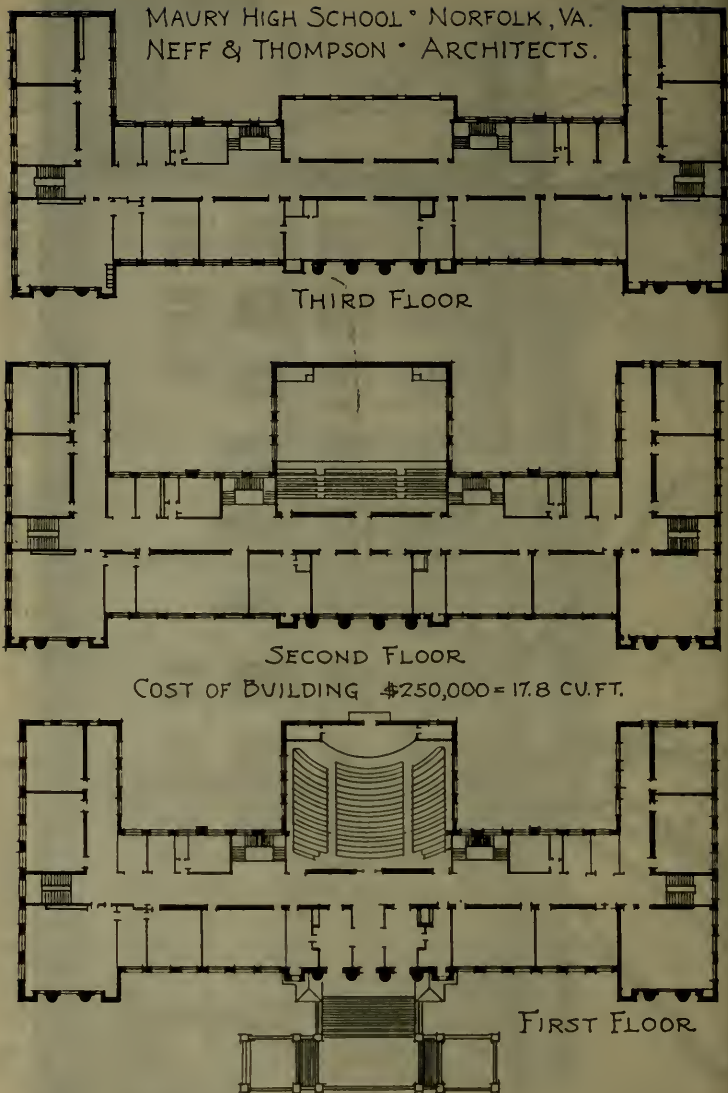


First Floor Plan

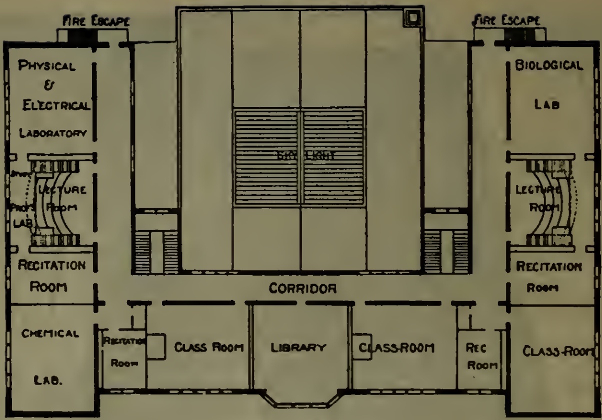
C. Granville Jones
Architect



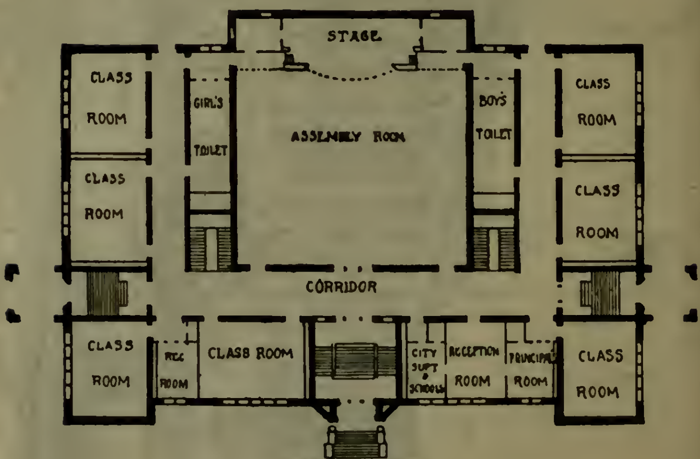
High School, at Bloomfield, N. J. C. Granville Jones, Architect, New York City. Cost $236,000. Fireproof.


MAURY HIGH SCHOOL · NORFOLK, VA.
NEFF & THOMPSON · ARCHITECTS.
THIRD FLOOR
SECOND FLOOR
COST OF BUILDING $250,000 = 17.8 CU. FT.
FIRST FLOOR

Maury High School, Norfolk, Va. Neff & Thompson, Architects, Norfolk. Cost equipped $275,000=17.9c per cu. ft. Fireproof.



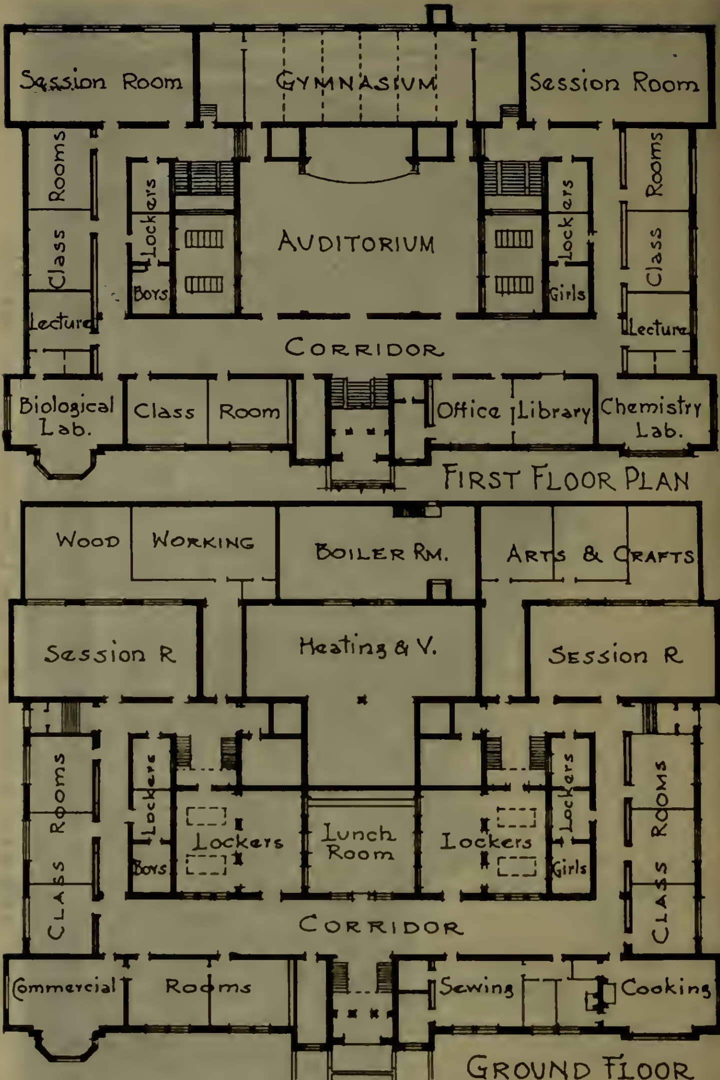
THIRD FLOOR PLAN



FIRST FLOOR PLAN

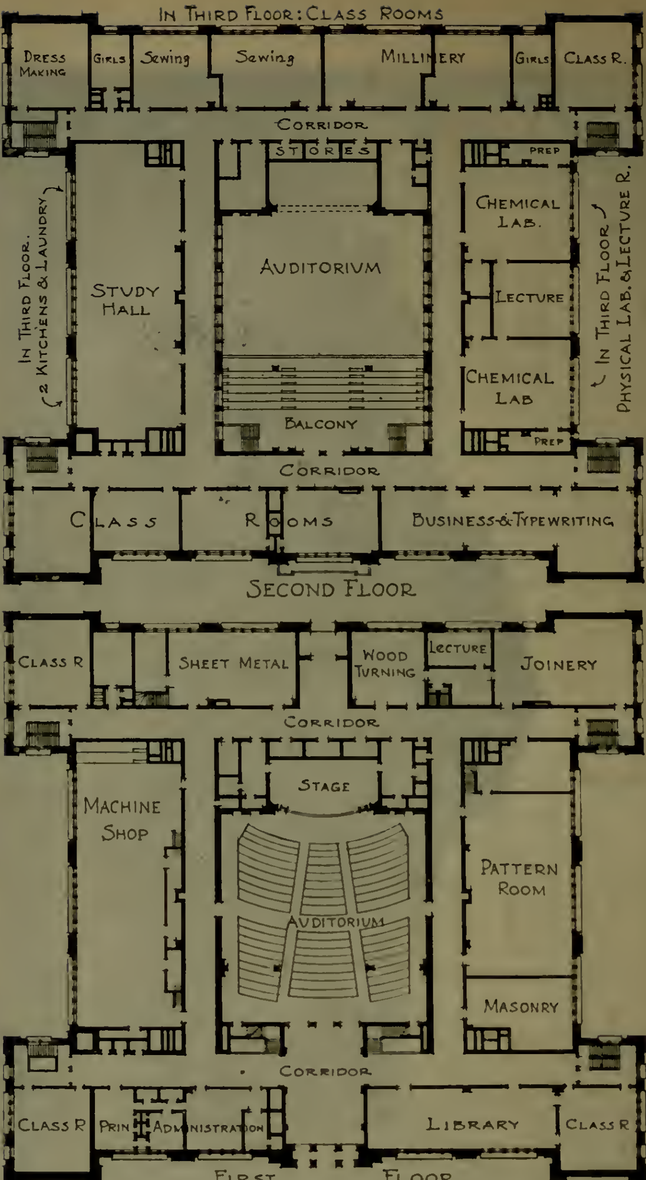
High School at Madison, Wis. Cass Gilbert, Architect, New York.

High School at Madison, Wis. Cass Gilbert, Architect, New York City.



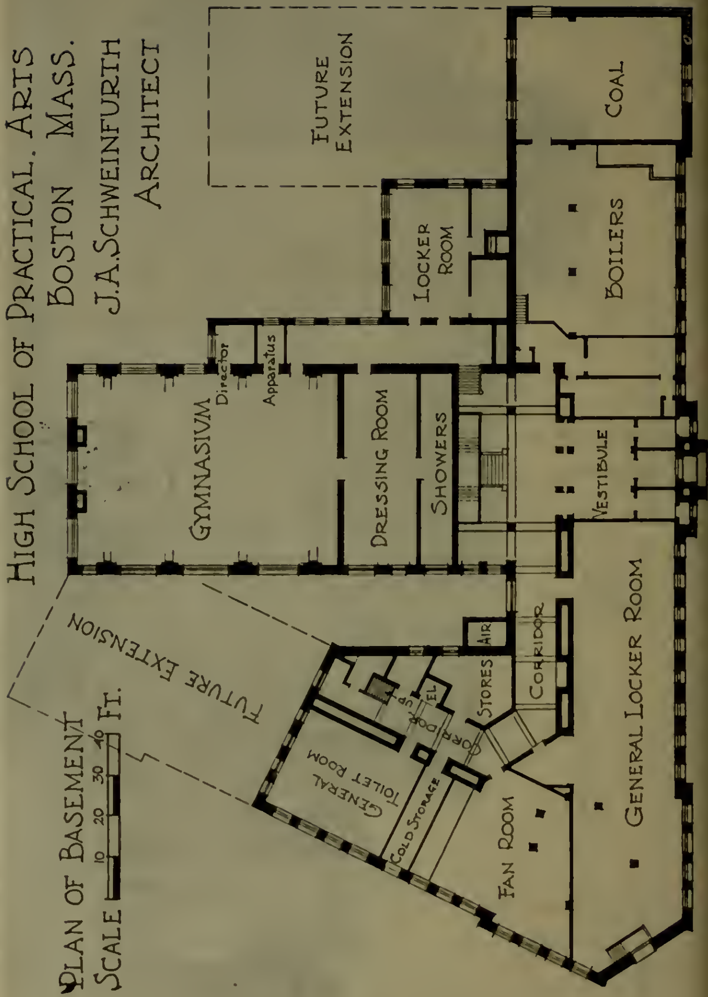
HIGH SCHOOL • LAFAYETTE IND • WM. B. ITTNER ARCH'T.

High School at Lafayette Indiana. Wm. B. Ittner, Architect.

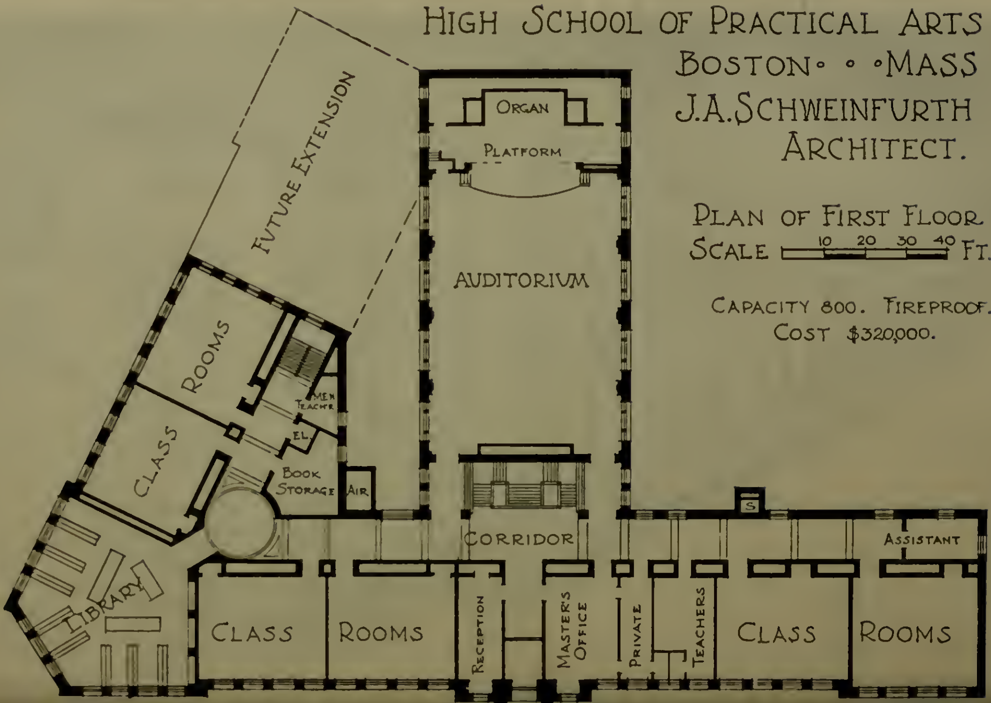


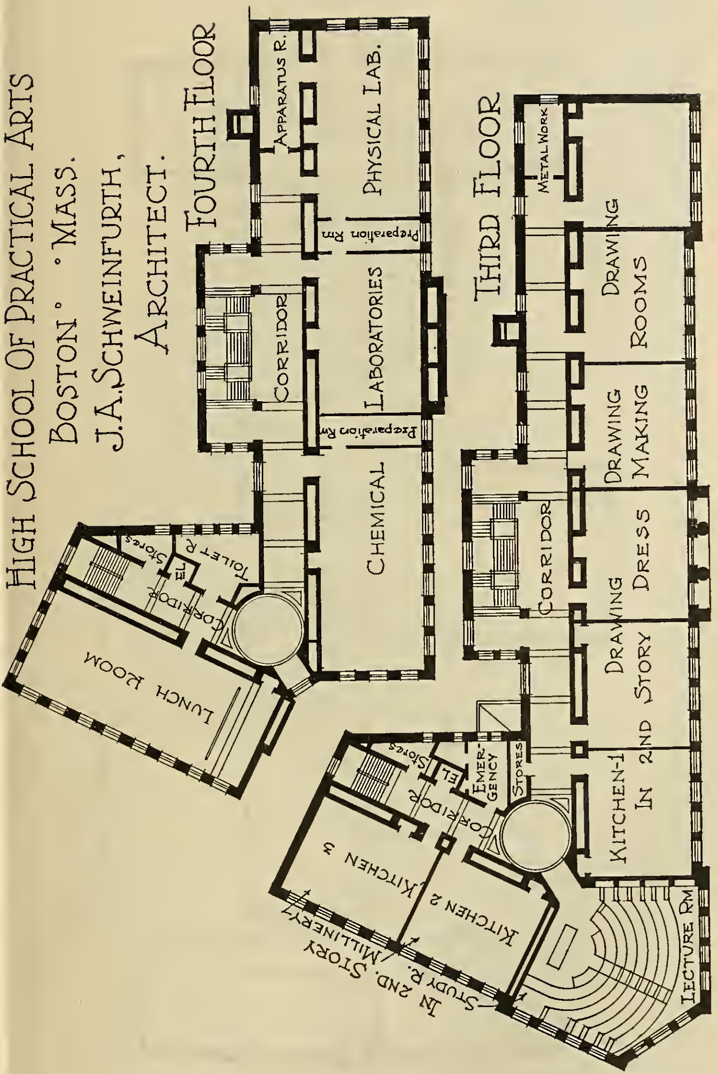
CENTRAL COMMERCIAL & MANUAL TRAINING HIGH SCHOOL
NEWARK N. J. • E. F GUILBERT • ARCHITECT.

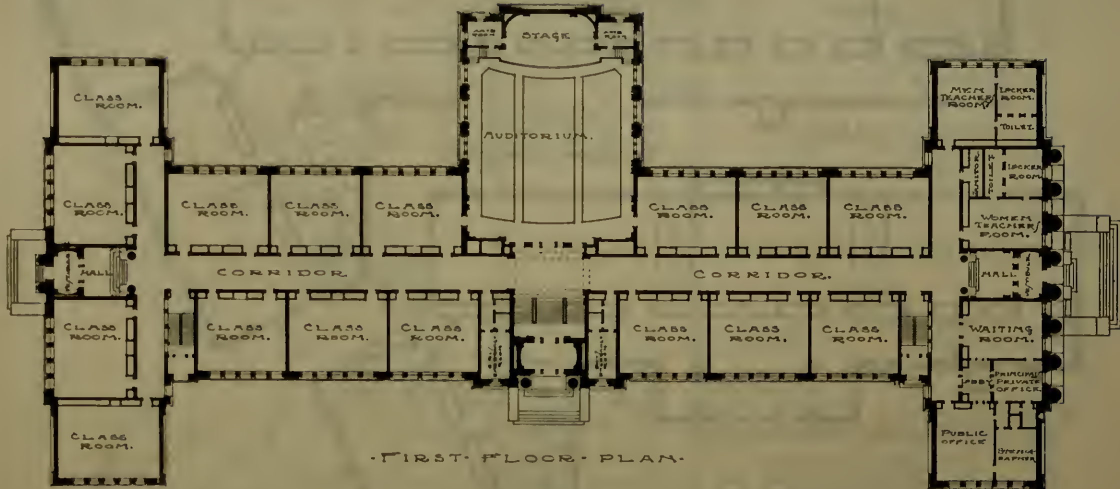
Central Commercial and Manual Training High School, Newark, N. J. E. F. Guilbert, Architect.


HIGH SCHOOL OF PRACTICAL ARTS
BOSTON MASS.
J.A. SCHWEINFURTH
ARCHITECT
PLAN OF BASEMENT
SCALE 10 20 30 40 FT.
FUTURE EXTENSION
COAL
BOILERS
LOCKER ROOM
GYMNASIUM
Director
Apparatus
DRESSING ROOM
SHOWERS
VESTIBULE
GENERAL LOCKER ROOM
CORRIDOR
AIR
STORES
FUTURE EXTENSION
GENERAL TOILET ROOM
COLD STORAGE
FAN ROOM

High School of Practical Arts, Boston, Mass. J. A. Schweinfurth, Architect, Boston.

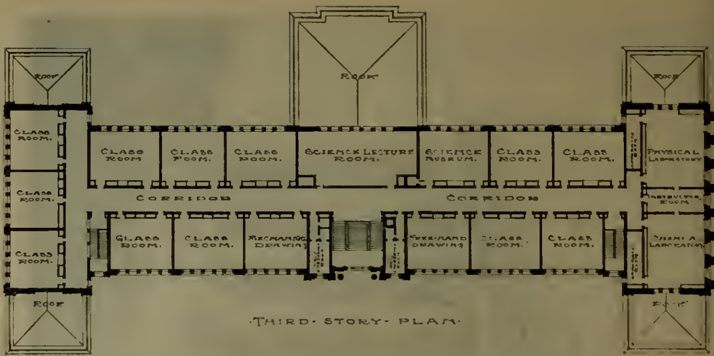

HIGH SCHOOL OF PRACTICAL ARTS
BOSTON • • MASS
J.A.SCHWEINFURTH
ARCHITECT.
PLAN OF FIRST FLOOR
SCALE 10 20 30 40 FT.
CAPACITY 800. FIREPROOF.
COST $320,000.
FUTURE EXTENSION
ORGAN
PLATFORM
AUDITORIUM
ROOMS
CLASS
BOOK STORAGE
AIR
EL.
CORRIDOR
ASSISTANT
LIBRARY
CLASS
ROOMS
RECEPTION
MASTER'S OFFICE
PRIVATE
TEACHERS
CLASS
ROOMS


HIGH SCHOOL OF PRACTICAL ARTS
BOSTON · MASS.
J.A. SCHWEINFURTH,
ARCHITECT.
FOURTH FLOOR
APPARATUS R.
PHYSICAL LAB.
Preparation Rm
CORRIDOR
LABORATORIES
Preparation Rm
CHEMICAL
TOILET R.
Stores
EL
CORRIDOR
CORRIDOR
LUNCH ROOM
THIRD FLOOR
METAL WORK
DRAWING ROOMS
DRAWING MAKING
CORRIDOR
DRESS
DRAWING STORY
KITCHEN-1 IN 2ND STORY
STORES
EMER-GENCY
EL
Stores
CORRIDOR
CORRIDOR
KITCHEN 3
KITCHEN 2
LECTURE RM
IN 2ND. STORY
MILLINERY
STUDY R.

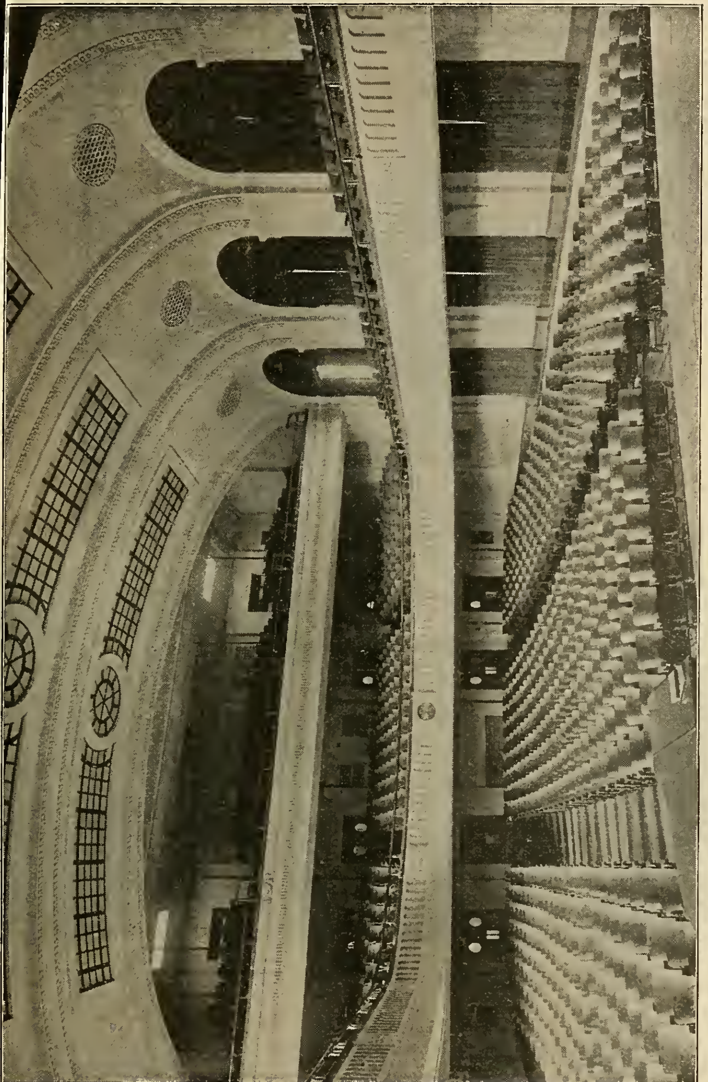


High School, Albany, N. Y. Starrett and Van Vleck, Architects, New York City.

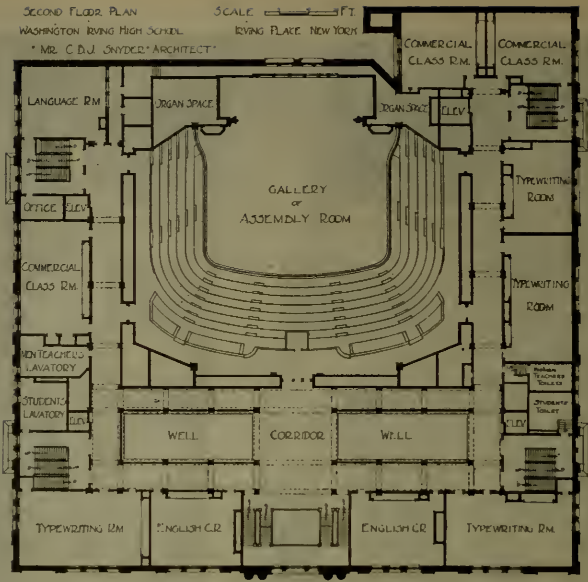
High School, Albany, N. Y. Starrett and Van Vleck, Architects, New York City.



High School at Albany, N. Y. Starrett and Van Vleck, Architects, New York City.



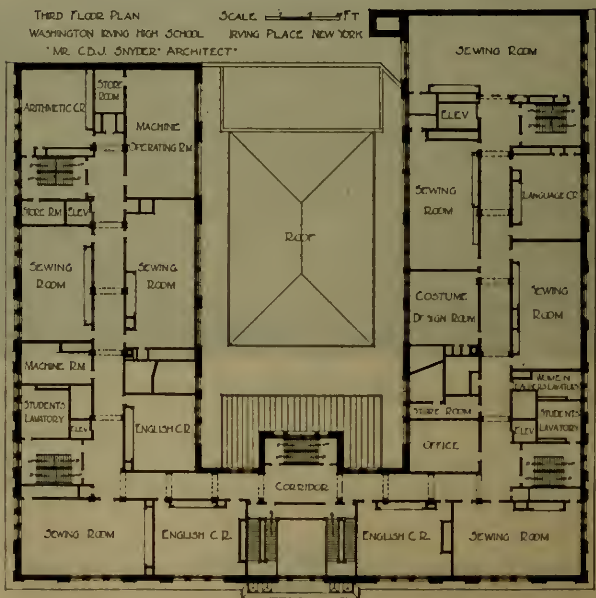
Auditorium, looking from stage. High School at Albany, N. Y. Starrett and Van Vleck, Architects, New York.

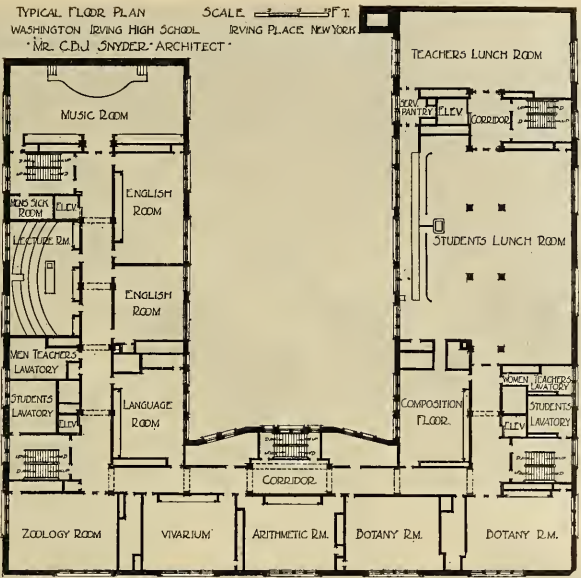

SECOND FLOOR PLAN
SCALE FT.
WASHINGTON IRVING HIGH SCHOOL
IRVING PLACE NEW YORK
MR. C. B. J. SNYDER ARCHITECT
COMMERCIAL CLASS RM.
COMMERCIAL CLASS RM.
LANGUAGE RM
ORGAN SPACE
ORGAN SPACE
ELEV
GALLERY of ASSEMBLY ROOM
OFFICE
ELEV
TYPEWRITING ROOM
COMMERCIAL CLASS RM.
TYPEWRITING ROOM
MEN TEACHERS LAVATORY
STUDENTS LAVATORY
ELEV
WELL
CORRIDOR
WELL
ELEV
TYPEWRITING RM
ENGLISH C.R
ENGLISH C.R
TYPEWRITING RM


FIRST FLOOR PLAN SCALE FT
WASHINGTON IRVING HIGH SCHOOL — IRVING PLACE NEW YORK
MR. C. B. J. SNYDER ARCHITECT
RETIRING ROOM
RETIRING ROOM
STORE ROOM
BINDERY
SUPPLY ROOM
PREP RM
ORGAN SPACE
PLATFORM
ORGAN SPACE
STORE RM
ELEV
LIBRARY C.R
ASSEMBLY ROOM
CORRIDOR
TYPEWRITING ROOM
LIBRARY
WELL ABOVE
ENTRANCE HALL
WELL ABOVE
EXHIBITION & SALES ROOM
EVE'G SCHOOL
GENERAL OFFICE
PRINCIPAL'S OFFICE
VESTIBULE

Washington Irving High School, New York City. C. B. J. Snyder, Architect.


FOURTH FLOOR PLAN
SCALE FT.
WASHINGTON IRVING HIGH SCHOOL
IRVING PLACE NEW YORK
"MR. C.B.J. SNYDER" ARCHITECT"
KITCHEN
GENERAL HOUSEKEEPING ROOM
STORE RM
STORE RM
ELEV
STORE RM
ELEV
STUDENTS LUNCH ROOM
GYMNASIUM
COOKING ROOM
PHYSICAL TRAINING OFFICE
LAVATORY
STUDENTS LAVATORY
SICK ROOM
ELEV
LOCKER RM
COMPOSITION FLOOR
ELEV
WOMENS SICK RM
OFFICE
CLOSET
CORRIDOR
COOKING ROOM
LAUNDRY
DOMESTIC SCIENCE
COOKING ROOM
COOKING ROOM


THIRD FLOOR PLAN
SCALE FT
WASHINGTON IRVING HIGH SCHOOL
IRVING PLACE NEW YORK
"MR. C.B.J. SNYDER" ARCHITECT"
SEWING ROOM
STORE ROOM
ARITHMETIC C.R.
MACHINE OPERATING RM
ELEV
STORE RM
ELEV
SEWING ROOM
LANGUAGE C.R.
ROOF
SEWING ROOM
SEWING ROOM
COSTUME DESIGN ROOM
SEWING ROOM
MACHINE RM
STUDENTS LAVATORY
ELEV
ENGLISH C.R.
STORE ROOM
OFFICE
STUDENTS LAVATORY
ELEV
CORRIDOR
SEWING ROOM
ENGLISH C.R.
ENGLISH C.R.
SEWING ROOM

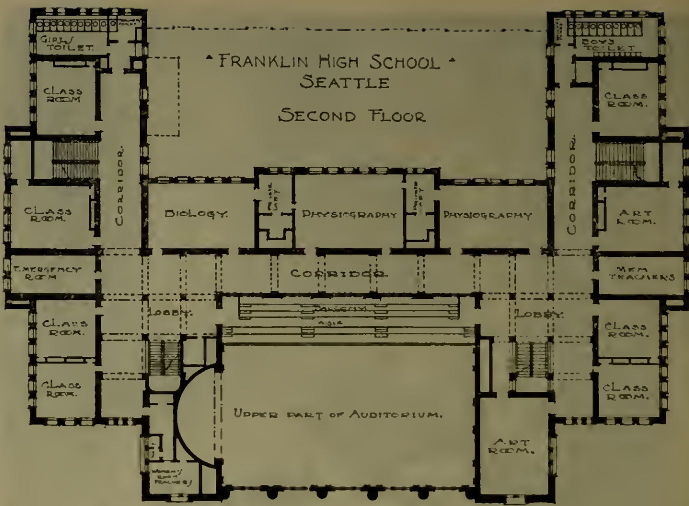


Entrance Foyer, Washington Irving High School, New York.

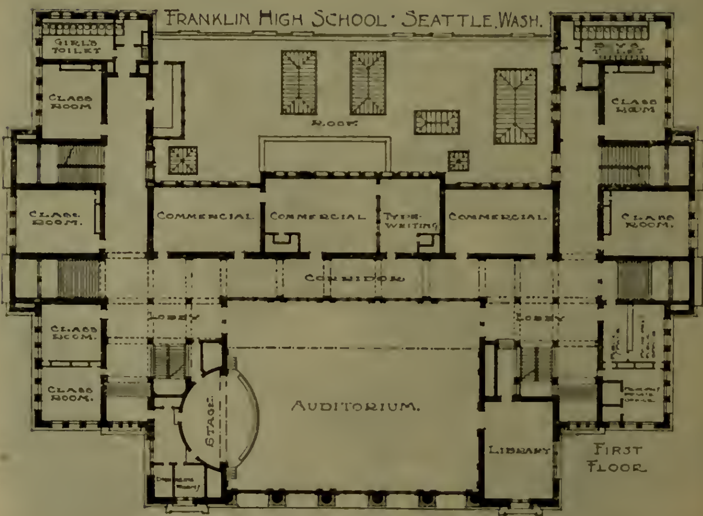
On the roof; Washington Irving High School, New York.

Auditorium—Washington Irving High School, New York, equipped as a theater. C. B. J. Snyder, Architect.

Book Bindery—Washington Irving High School, New York City. C. B. J. Snyder, Architect.

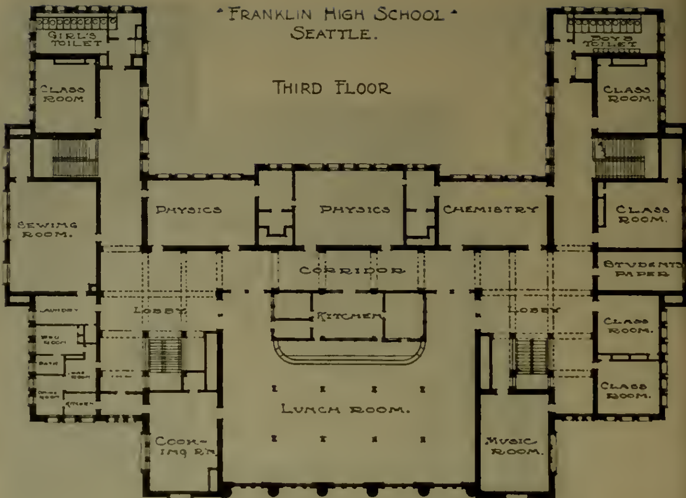


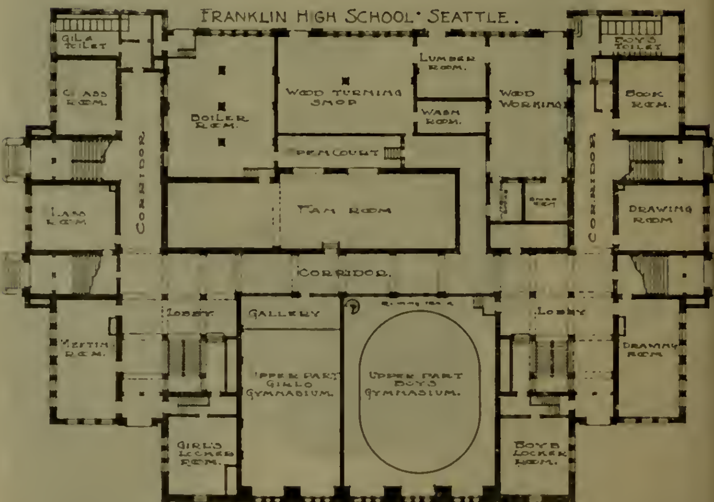
FRANKLIN HIGH SCHOOL
SEATTLE
SECOND FLOOR
GIRLS TOILET
CLASS ROOM
CORRIDOR
BIOLOGY
PHYSIOGRAPHY
PHYSIOGRAPHY
ART ROOM
EMERGENCY ROOM
CORRIDOR
MEN TEACHERS
LOBBY
LOBBY
CLASS ROOM
UPPER PART OF AUDITORIUM.
ART ROOM.



FRANKLIN HIGH SCHOOL · SEATTLE.WASH.
GIRLS TOILET
CLASS ROOM
ROOF
COMMERCIAL.
COMMERCIAL
TYPE-WRITING
COMMERCIAL.
CORRIDOR
LOBBY
LOBBY
CLASS ROOM.
STAGE.
AUDITORIUM.
LIBRARY
FIRST FLOOR

Franklin High School, Seattle, Wash. Edgar Blair Architect. Fireproof. Cost $426,000=15c. per cu. ft.


FRANKLIN HIGH SCHOOL
SEATTLE.
THIRD FLOOR
GIRL'S TOILET
CLASS ROOM
SEWING ROOM.
LAUNDRY
PHYSICS
PHYSICS
CHEMISTRY
BOYS TOILET
CLASS ROOM.
CLASS ROOM.
STUDENTS PAPER
CORRIDOR
LOBBY
KITCHEN
LOBBY
CLASS ROOM.
CLASS ROOM.
LUNCH ROOM.
COOKING R'M
MUSIC ROOM.

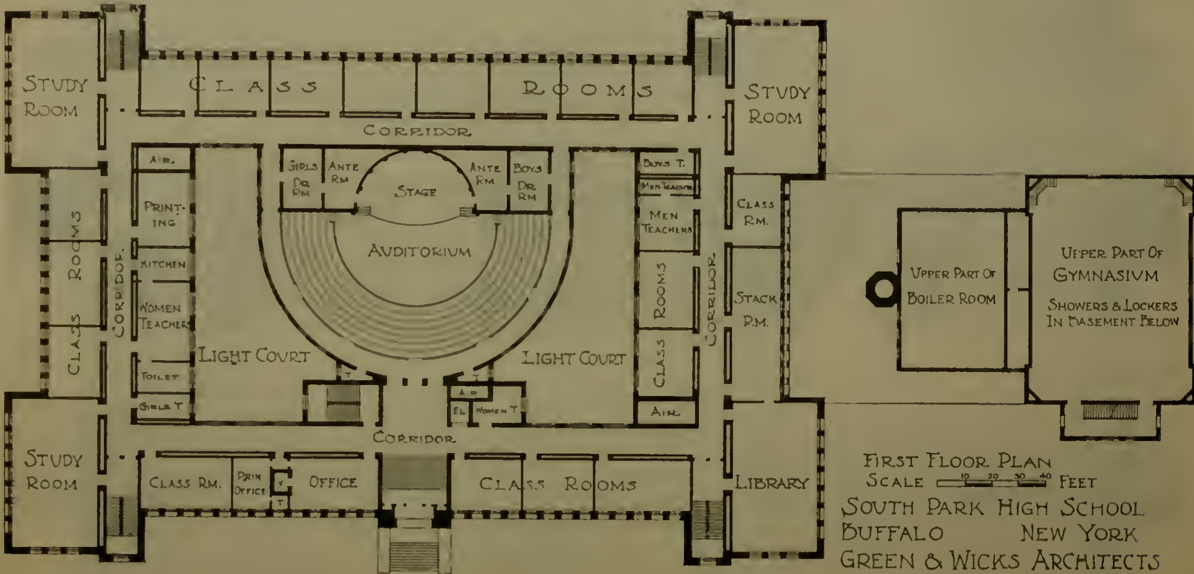

FRANKLIN HIGH SCHOOL · SEATTLE.
GIRLS TOILET
CLASS ROOM.
BOILER ROOM.
WOOD TURNING SHOP
LUMBER ROOM.
WASH ROOM.
WOOD WORKING
BOYS TOILET
BOOK ROOM.
CORRIDOR
FAN ROOM
CORRIDOR
DRAWING ROOM
CORRIDOR.
LOBBY
GALLERY
LOBBY
UPPER PART BOYS GYMNASIUM.
GYMNASIUM.
GIRLS LOCKER ROOM.
BOYS LOCKER ROOM.

BASEMENT

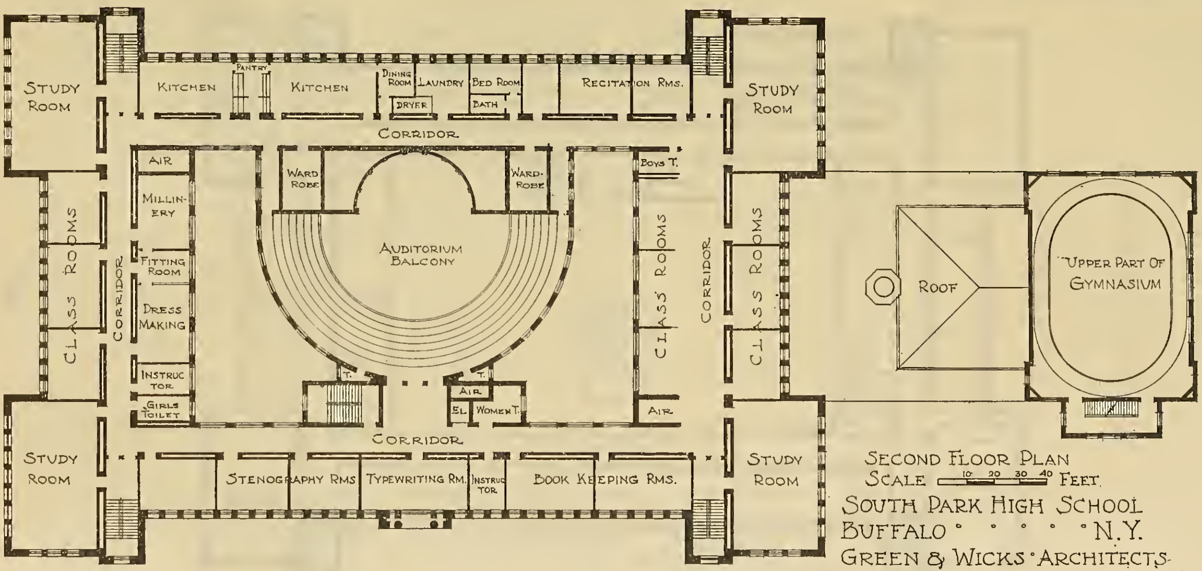
Franklin High School, Seattle, Washington. Edgar Blair, Architect.

Kitchen, Franklin High School, Seattle, Washington. Edgar Blair, Architect.

SOUTH · PARK · HIGH · SCHOOL
· BUFFALO · NEW · YORK ·
GREEN & WICKS, ARCHITECTS,

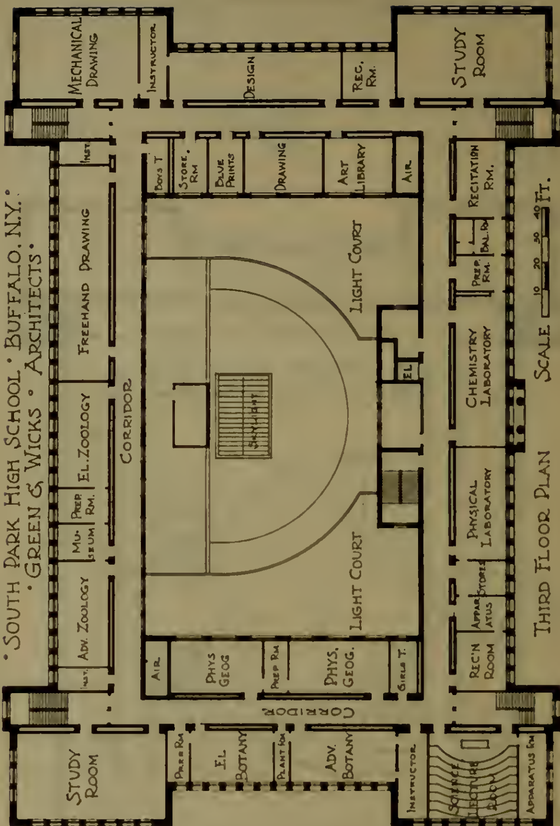


FIRST FLOOR PLAN
SCALE 10 20 30 40 FEET
SOUTH PARK HIGH SCHOOL
BUFFALO NEW YORK
GREEN & WICKS ARCHITECTS



Second Floor Plan
Scale 10 20 30 40 Feet

South Park High School
Buffalo • • • • • N.Y.
Green & Wicks • Architects



· South Park High School · Buffalo, N.Y. ·
· Green & Wicks · Architects ·

Third Floor Plan

GENERAL INDEX

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INDEX OF ARCHITECTS

This index has been prepared with the view of making it as convenient as possible, the subjects being indexed both by location and also with the name of the architects. Buildings having particular names are indexed both by that name and also the name of the city in which the building was erected. Throughout the index, the high schools are referred to as such. In general, buildings not classified as high schools are grade schools, or schools for some particular grade as noted in title.

In arranging the illustrations, grade schools are located between page 334 and page 416. From page 416 to page 598, the work is devoted entirely to high schools.

The author has been influenced by two motives in devoting more space to high school buildings than other types. (1) By the fact that there is a growing tendency throughout the country to include in grade buildings many features which have hitherto been found only in high school buildings, such as auditoriums, gymnasiums, manual training and domestic science rooms, rooms for the study of drawing, music and other subjects aside from the common branches. Most of the smaller high schools illustrated in this book, would be equally suitable for grade buildings if these and other facilities are desired in the building. (2) When the common branches only are taught in grade buildings, there is not nearly so much opportunity for variety in design as there is in buildings of the type above described, and an ample number of successful grade buildings have been illustrated to show the characteristics and practice in various parts of the country.

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INDEX OF BUILDINGS

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